User Manual

Allen-Bradley

Integrated Motion on the EtherNet/IP Network Configuration and Startup

ControlLogix, CompactLogix, Kinetix 350, Kinetix 5500, Kinetix 5700, Kinetix 6500, PowerFlex 755

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

	SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

Allen-Bradley, Rockwell Automation, ControlLogix, RSLinx, RSLogix, Rockwell Software, Kinetix, PowerFlex, Logix5000, Integrated Architecture, PhaseManager, DriveExecutive, ControlFLASH, Stratix 8000, POINT I/O, CompactLogix, GuardLogix, and Studio 5000 are trademarks of Rockwell Automation, Inc.

Trademarks not belonging to Rockwell Automation are property of their respective companies.

This manual contains new and updated information. Changes throughout this revision are marked with change bars, as shown to the right of this paragraph.

New and Updated Information

This table contains the major changes that are made in this revision.

Topic	Page
Added reference information about the Kinetix® 5700 Multi-axis Servo drive. For the Kinetix 5700 drive, see the Kinetix 5700 Multi-axis Servo Drives User Manual, publication 2198-UM002. Although, the Kinetix 5700 drive is included in several tables, for example, Compare the Axis Configuration Types for the Drives on page 32.	Throughout
Updated Screen captures.	Throughout

Notes:

Preface

Studio 5000 Environment 11
What You Need 12
Integrated Motion
EtherNet/IP Drives 13
Configuration and Start-up Scenarios 14
Help for Selecting Drives and Motors 16
Where to Find Sample Projects 16
For More Information 17

Chapter 1

Configure Integrated Motion Control Using Kinetix Drives

Configuring a Kinetix Drive 20
Add a Kinetix EtherNet/IP Drive 20
Create an Associated Axis 24
  Create an Axis for a Kinetix Drive 25
Configuring the General Parameters 28
  Associate Axes and Drives 29
  Configure the Associated Axis and Control Mode 31
  Create a Motion Group 34
  Associate the Axis to the Motion Group 36
  Set the Base Update Period 37
Specifying the Motor Data Source 39
  Choose the Catalog Number 39
  Choose Nameplate 41
  Choose Motor NV 42
Display Motor Model Information 42
Assign Motor Feedback 43
Configuring the Load Feedback 44
Configuring the Master Feedback 45
Create Reports 45

Chapter 2

Configure Integrated Motion Using a PowerFlex 755 Drive

About the PowerFlex 755 Drives 48
Add a PowerFlex 755 Drive 49
  Select a Peripheral Feedback Device and Slot Assignment 51
  Assign a Power Structure 52
Create an Axis for a PowerFlex 755 Drive 54
  Establish Feedback Port Assignments for the PowerFlex 755 Drive 56
  Configure the Associated Axis and Control Mode 59
  Create a Motion Group 62
  Associate the Axis to the Motion Group 64
  Set the Base Update Period 65
Select the Motor Data Source 67
  Choose Catalog Number as the Motor Data Source 67
  Motor Model Dialog Box 68
  Motor Analyzer Dialog Box 68

Choose Nameplate as the Motor Data Source 69
Choose Drive NV as the Data Source. 70
Motor Model Dialog Box. 71
Motor Analyzer Dialog Box 71
Feedback Configuration Options for the PowerFlex 755 Drive . . . 73

Chapter 3

Configure Axis Scheduling

Example Axis Scheduling Application 78
Axis Scheduling Configuration 79
Configuring the Update Periods 80
Motion Utilization 87

Chapter 4

Configure a Project for Integrated Motion on the EtherNet/IP Network

Create a Controller Project. 89
Set Time Synchronization. 92
Add a 1756-ENxTx Communication Module 95

Chapter 5

Configuration Examples for a Kinetix Drive

Example 1: Position Loop with Motor Feedback Only. 99
Example 2: Position Loop with Dual Feedback. 103
Example 3: Feedback Only 108
Example 4: Kinetix 5500 Drive, Velocity Loop with Motor Feedback 112
Example 5: Kinetix 350 Drive, Position Loop with Motor Feedback . 116

Chapter 6

Axis Configuration Examples for the PowerFlex 755 Drive

Example 1: Position Loop with Motor Feedback Using a UFB Feedback Device 122
Example 2: Position Loop with Dual Motor Feedback Via a UFB Feedback Device 125
Example 3: Velocity Loop with Motor Feedback Via a UFB Feedback Device. 130
Example 4: Velocity Loop with No Feedback 134
Example 5: Frequency Control with No Feedback. 137
Example 6: Torque Loop with Feedback. 141

Chapter 7

Commission

Scaling Dialog Box. 146
Direct Coupled Rotary. 147
Direct Coupled Linear 148
Rotary Transmission. 148
Linear Actuator 149
Hookup Tests Dialog Box. 150
Test Cable Connections, Wiring, and Motion Polarity. 151
Run a Motor and Feedback Test 153
Run a Motor Feedback Test 155

Run a Marker Test 155
Commutation Test 156
Applying the Commutation Hookup Test 156
Run a Commutation Test 159
Polarity Dialog Box 160
Autotune Dialog Box 160
Load Dialog Box 164
Load Observer 166
Motion Analyzer Software 169
Test an Axis with Motion Direct Commands 170
Access Motion Direct Commands for an Axis or Group 170
Understanding STO Bypass When Using Motion Direct Commands 173
Troubleshoot the Safe Torque Off Function 174

Chapter 8

Home an Axis

Guidelines for Homing 175
Active Homing 176
Passive Homing 176
Examples 177
Active Homing 177
Passive Homing 181
Absolute Position Recovery (APR) 182
APR Terminology 182
APR Supported Components 182
Absolute Position Recovery Functionality 183
Absolute Feedback Device 183
Sercos Versus CIP 183
APR Faults 184
APR Fault Conditions 184
APR Fault Generation 185
Absolute Position Recovery Scenarios 187
Scaling 191
Online Scaling 192
Resetting an APR Fault 192
Absolute Position Loss without APR Faults 192
Behavior of APR for Incremental Encoders 193
Saving an ACD File Versus Upload of a Project 194

Chapter 9

Manual Tune

Manual Tune an Axis 195
Axis Configuration Types 196
Current Tuning Configuration 196
Loop Responses 197
Motion Generator and Motion Direct Commands 199
Additional Tune 201

Additional Tune for the Kinetix 6500 Module 201
Configure Torque Values. 203
Additional Tune for the PowerFlex 755 Drive 205
Quick Watch. 207
Motion Generator 208

Chapter 10

Faults and Alarms

Faults and Alarms Dialog Box 211
QuickView Pane. 213
Data Monitor 213
Drive Status Indicators. 214
Troubleshoot Faults 214
Manage Motion Faults. 215
Configure the Exception Actions for AXIS_CIP_DRIVE 216
Inhibit an Axis 219
Example: Inhibit an Axis 220
Example: Uninhibit an Axis 221

Appendix A

CIP Drive Module Properties

Module Properties. 223
General Tab. 224
Connection Tab. 226
Safety Tab 227
Time Sync Tab 228
Module Info Tab 229
Internet Protocol Tab. 231
Port Configuration Tab. 233
Network Tab. 237
Associated Axes Tab 240
Power Tab 244
Digital Input Tab. 247
Motion Diagnostics Tab 248

Appendix B

Parameter Group Dialog Boxes

Parameter Dialog Box Listings. 251

Appendix C

Program

Program a Velocity Profile and Jerk Rate 255
Definition of Jerk. 255
Choose a Profile 256
Use % of Time for the Easiest Programming of Jerk. 257
Velocity Profile Effects 258
Jerk Rate Calculation 258
Profile Operand 263
Enter Basic Logic 266

Example Motion Control Program 267
Download a Project and Run Logix 268
Choose a Motion Instruction 268
Troubleshoot Axis Motion..... 271
Why does my axis accelerate when I stop it?..... 271
Why does my axis overshoot its target speed? 272
Why is there a delay when I stop and then restart a jog?..... 275
Why does my axis reverse direction when I stop and start it? 277
Programming with the MDSC Function..... 279

Appendix D

History of Changes History of Changes..... 283
Glossary Glossary.....285
Index Index.....289

Notes:

Use this manual to configure an Integrated Motion on the EtherNet/IP network application and to start up your motion solution using the ControlLogix® and CompactLogix™ systems.

Topic	Page
What You Need	12
Integrated Motion EtherNet/IP Drives	13
Configuration and Start-up Scenarios	14
Help for Selecting Drives and Motors	16
Where to Find Sample Projects	17

This manual is designed to give you the quickest and easiest approach to an integrated motion control solution. If you have any comments or suggestions, see Documentation Feedback on the back cover of this manual.

Studio 5000 Environment

The Studio 5000 Automation Engineering and Design Environment™ combines engineering and design elements into a common environment. The first element in the Studio 5000® environment is the Studio 5000Logix Designer™ application. The Logix Designer application is the rebranding of RSLogix™ 5000 software and continue to be the product to program Logix5000™ controllers for discrete, process, batch, motion, safety, and drive-based solutions.

The Studio 5000 environment is the foundation for the future of Rockwell Automation® engineering design tools and capabilities. The Studio 5000 environment. It is the one place for design engineers to develop all elements of their control system.

What You Need

You need a combination of the following hardware and software to configure an integrated motion solution:

- ControlLogix controllers (supports up to 100 position loop configured drives) that support integrated motion control:
  - 1756-L7*x*
  - 1756-L7*x*S

    TIP ControlLogix controllers 1756-L6*x* and L6*x*S are not supported in Logix Designer application, version 21.00.00 and later.

- CompactLogix 5370 L1, L2, and L3 family of controllers have the embedded EtherNet/IP network, which supports integrated motion control

  The CompactLogix controllers that support the AXIS_CIP_DRIVE axis type:
  - 1769-L18ERM, up to 8 drives and 2 position loops
  - 1769-L27ERM, up to 16 drives and 4 position loops
  - 1769-L30ERM, up to 16 drives and 4 position loops
  - 1769-L33ERM, up to 32 drives and 8 position loops
  - 1769-L36ERM, up to 48 drives and 16 position loops
- Ethernet communication modules, with updated firmware to version 3.3 or later:
  - 1756-EN2T
  - 1756-EN2TR
  - 1756-EN3TR
  - 1756-EN2F
- Integrated Motion EtherNet/IP control modules, drives, and adapters:
  - Kinetix 350 Ethernet drive, single axis servo drive, with RSLogix 5000 programming software, version 20.00.00, or the Logix Designer application, version 21.00.00 or later
  - Kinetix 5500 mid-range Ethernet servo drive, with the Logix Designer application, version 21.00.00 or later
  - Kinetix 5700, multi-axis servo drive, with the Logix Designer application, version 26.00.00 or later.
  - Kinetix 6500 control module, multi-axis servo drive with RSLogix 5000 programming software, version 18.00.00 or later, or the Logix Designer application, version 21.00.00 or later
  - PowerFlex® 755 Embedded EtherNet/IP drive, with RSLogix 5000 programming software, version 19.00.00...20.00.00 or later, or the Logix Designer application, version 21.00.00 or later
- Logix Designer application, version 21.00.00 or later
- RSLinx® Classic software, version 3.51.00 or later

Integrated Motion EtherNet/IP Drives

This table lists the EtherNet/IP drives available for integrated motion.

Table 1 - Integrated Motion EtherNet/IP Drives

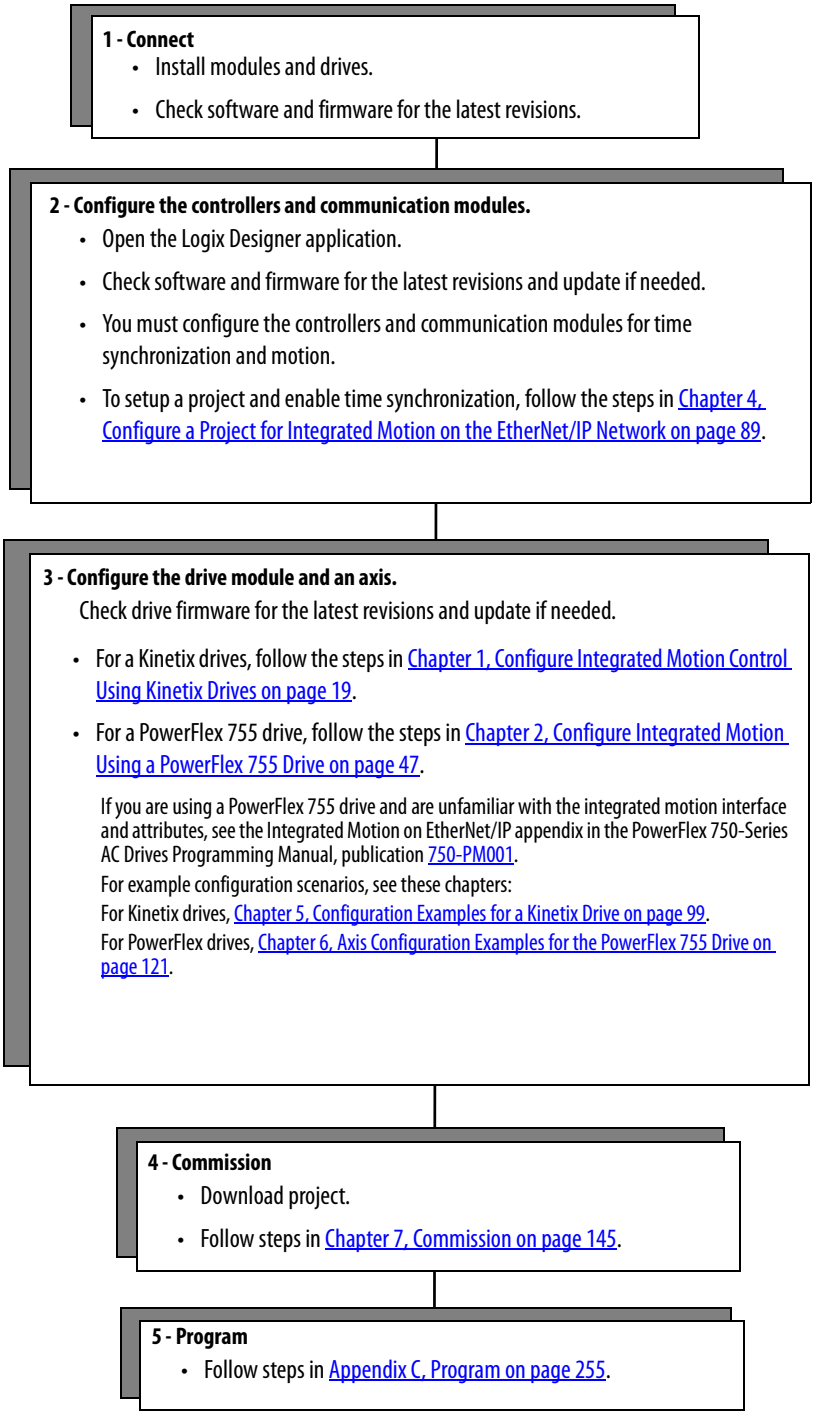
Drive	Description	Supported Axis Types[1]	Voltage Ranges	Resources
Kinetix 350	The Kinetix 350 drive is a single-axis EtherNet/IP servo drive with Safe Torque Off feature that support the Integrated Motion on EtherNet/IP network.	Position Velocity Torque	**Input power** 120/240V or 480V AC **Output power** 0.4…3.0 kW (2…12 A rms)	Kinetix 350 Single-axis EtherNet/IP Servo Drives User Manual, publication 2097-UM002
Kinetix 5500 Kinetix 5500 (ers)	The Kinetix 5500 single-axis servo drive that supports the Integrated Motion on EtherNet/IP network. Multi-axis, AC, DC, AC/DC, and AC/DC hybrid bus-sharing configurations are also possible.	Frequency Control Position Velocity Torque Kinetix 5500 (ers): Safe Torque Off	**Voltage Ranges** — **Output Power** 195…264V rms single-phase — 0.2…1.0 kW 195…264V rms three-phase — 0.3…7.2 kW 324…528V rms three-phase — 0.6…14.9 Kw	Kinetix 5500 Servo Drives User Manual, publication 2198-UM001
Kinetix 5700	The Kinetix 5700 is a Multi-axis EtherNet/IP servo drive with Safe Torque Off feature that supports the Integrated Motion on EtherNet/IP network. The Safe Torque Off is supported on the drive as either Hardwired-STO(ers) or Network-STO(ers2), combined on one Drive Catalog(ers3) 2198-K5700. It consists of a Converter module (DFE), Inverter modules HI-power (HPI), and Dual-Axis DAI in 200amp Shared DC-Bus, Bus-Sharing configurations with DFE as DC Converter.	Frequency Control Feedback Only Position Velocity Torque Kinetix 5700 (ers): Safe Torque Off	324…528V rms, three-phase (480V nom) AC	Kinetix 5700 Multi-axis Servo Drive User Manual, publication 2198-UM002
Kinetix 6500	The Kinetix 6500 drive is a closed loop servo modular drive. It consists of an integrated axis (IAM) power module and up to seven axis (AM) power modules, each coupled with a Kinetix 6500 control module. The IAM and AM power modules provide power for up to eight drives.	Feedback Only Position Velocity Torque	**Voltage Range** 324…528V rms three-phase **Continuous Output Power** 6.0…45 kW	Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002
PowerFlex 755	The PowerFlex 755 Drive EtherNet/IP Embedded Adapter is a closed loop drive. It consists of an integrated axis power module and five configuration option slots for control, communication, I/O, feedback, safety, and auxiliary control power.	Frequency Control Position Velocity Torque	**Input Power:** 380…480V AC **Output Power:** 0.75...1400 kW / 1...2000 Hp / 2.1...2330 A **Input Power:** 600V AC **Output Power:** 0.5...1500 Hp / 1.7...1530 A **Input Power:** 690V AC **Output Power:** 5.5...1500 kW / 12...1485 A	PowerFlex 755 Drive Embedded EtherNet/IP Adapter Installation Instructions, publication 750-IN001 PowerFlex 750-Series AC Drives Programming Manual, publication 750-PM001

(1) For more information about the configuration types, see Configure the Associated Axis and Control Mode on page 31 and the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003.

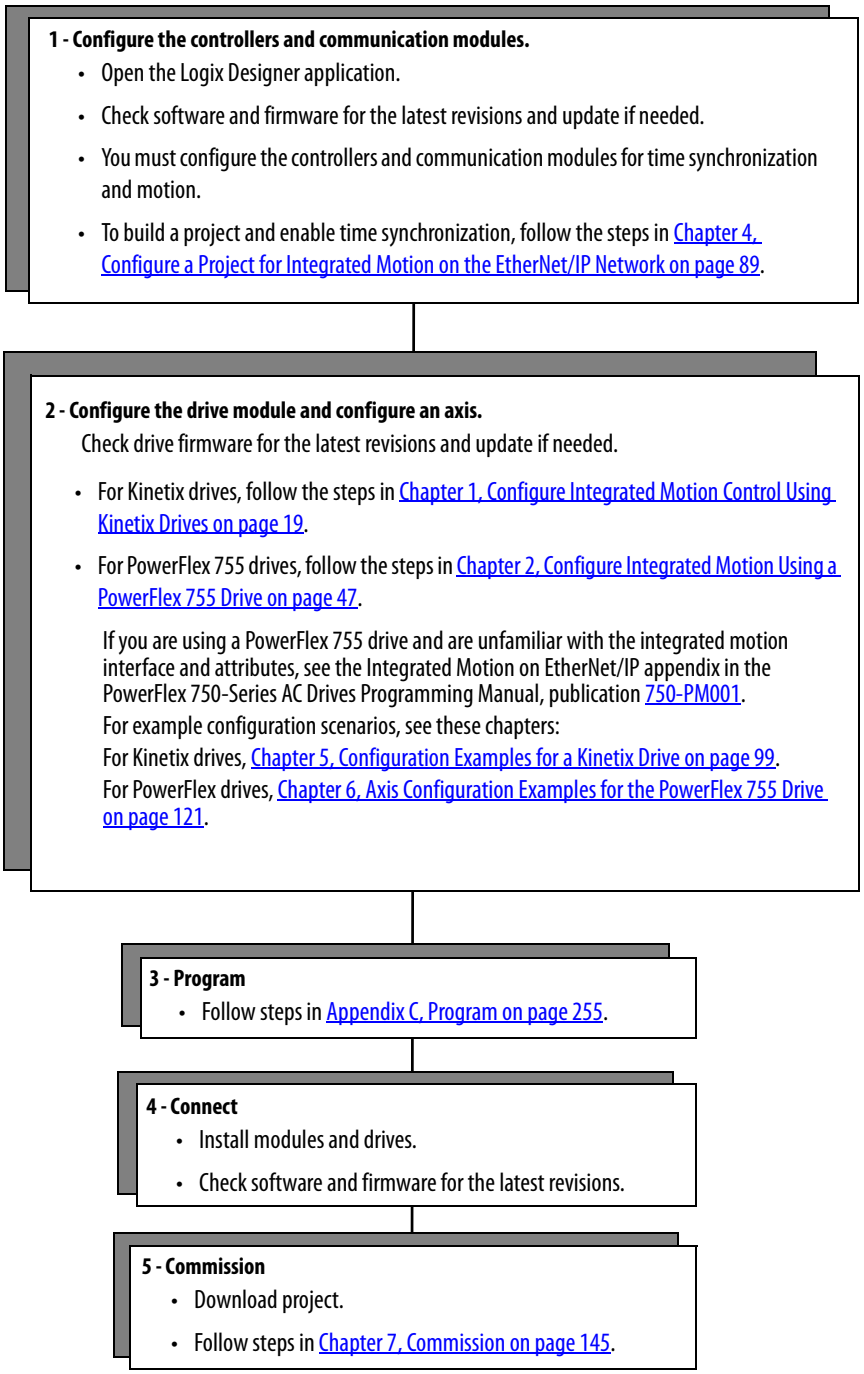
Configuration and Start-up Scenarios

The two ways to get an Integrated Motion on the EtherNet/IP network solution up and running are to connect the hardware first or configure the software.

Connect Hardware First


1 - Connect
• Install modules and drives.
• Check software and firmware for the latest revisions.
2 - Configure the controllers and communication modules.
• Open the Logix Designer application.
• Check software and firmware for the latest revisions and update if needed.
• You must configure the controllers and communication modules for time synchronization and motion.
• To setup a project and enable time synchronization, follow the steps in Chapter 4, Configure a Project for Integrated Motion on the EtherNet/IP Network on page 89.
3 - Configure the drive module and an axis.
Check drive firmware for the latest revisions and update if needed.
• For a Kinetix drives, follow the steps in Chapter 1, Configure Integrated Motion Control Using Kinetix Drives on page 19.
• For a PowerFlex 755 drive, follow the steps in Chapter 2, Configure Integrated Motion Using a PowerFlex 755 Drive on page 47.
If you are using a PowerFlex 755 drive and are unfamiliar with the integrated motion interface and attributes, see the Integrated Motion on EtherNet/IP appendix in the PowerFlex 750-Series AC Drives Programming Manual, publication 750-PM001.
For example configuration scenarios, see these chapters:
For Kinetix drives, Chapter 5, Configuration Examples for a Kinetix Drive on page 99.
For PowerFlex drives, Chapter 6, Axis Configuration Examples for the PowerFlex 755 Drive on page 121.
4 - Commission
• Download project.
• Follow steps in Chapter 7, Commission on page 145.
5 - Program
• Follow steps in Appendix C, Program on page 255.

Configure Software First


1 - Configure the controllers and communication modules.
• Open the Logix Designer application.
• Check software and firmware for the latest revisions and update if needed.
• You must configure the controllers and communication modules for time synchronization and motion.
• To build a project and enable time synchronization, follow the steps in Chapter 4, Configure a Project for Integrated Motion on the EtherNet/IP Network on page 89.
2 - Configure the drive module and configure an axis.
Check drive firmware for the latest revisions and update if needed.
• For Kinetix drives, follow the steps in Chapter 1, Configure Integrated Motion Control Using Kinetix Drives on page 19.
• For PowerFlex 755 drives, follow the steps in Chapter 2, Configure Integrated Motion Using a PowerFlex 755 Drive on page 47.
If you are using a PowerFlex 755 drive and are unfamiliar with the integrated motion interface and attributes, see the Integrated Motion on EtherNet/IP appendix in the PowerFlex 750-Series AC Drives Programming Manual, publication 750-PM001.
For example configuration scenarios, see these chapters:
For Kinetix drives, Chapter 5, Configuration Examples for a Kinetix Drive on page 99.
For PowerFlex drives, Chapter 6, Axis Configuration Examples for the PowerFlex 755 Drive on page 121.
3 - Program
• Follow steps in Appendix C, Program on page 255.
4 - Connect
• Install modules and drives.
• Check software and firmware for the latest revisions.
5 - Commission
• Download project.
• Follow steps in Chapter 7, Commission on page 145.

Help for Selecting Drives and Motors

Motion Analyzer software helps you select the appropriate Allen-Bradley® drives and motors that are based on your load characteristics and typical motion application cycles. The software guides you through wizard-like screens to collect information specific to your application.

After you enter the information for your application, such as, load inertia, gearbox ratio, feedback device, and brake requirements, the software generates an easy-to-read list of recommended motors, drives, and other support equipment.

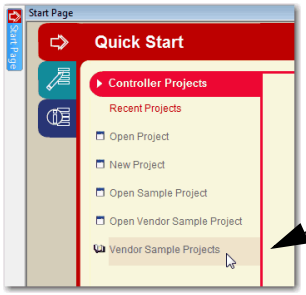
You can download the Motion Analyzer software at http://www.ab.com/motion/software/analyzer_download.html.

Where to Find Sample Projects

There are three ways to find the sample projects:

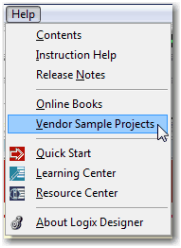
- Studio 5000 Main Dialog Box

- Logix Designer Start Page (ALT+F9)



There is a PDF file that is named Vendor Sample Projects on the Start Page that explains how to work with the sample projects.

- Logix Designer Help Menu



The Rockwell Automation sample project default location is:

C:\Users\Public\Documents\Studio 5000\Samples\ENU\V24\Rockwell Automation

There is a PDF file that is named Vendor Sample Projects on the Start Page that explains how to work with the sample projects.

Free sample code is available at: http://samplecode.rockwellautomation.com/.

For More Information

These resources contain information about related products from Rockwell Automation.

Table 2 - Publications About Related Products

Resource	Description
Logix5000 Controller Motion Instructions Reference Manual, publication MOTION-RM002	Provides a programmer with details about motion instructions for a Logix-based controller.
Integrated Motion on the EtherNet/IP network Reference Manual, publication MOTION-RM003	Provides a programmer with details about the Integrated Motion on the EtherNet/IP network Control Modes, Control Methods, and AXIS_CIP_DRIVE Attributes.
Logix5000 Controllers Quick Start, publication 1756-QS001	Describes how to get started programming and maintaining Logix5000 controllers.
Logix5000 Controllers Common Procedures, publication 1756-PM001	Provides detailed and comprehensive information about how to program a Logix5000 controller.
Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003	Provides a programmer with details about general instructions for a Logix-based controller.
Logix5000 Controllers Process and Drives Instructions Reference Manual, publication 1756-RM006	Provides a programmer with details about process and drives instructions for a Logix-based controller.
The Integrated Architecture™ and CIP Sync Configuration Application Technique, publication IA-AT003	Provides detailed configuration information on CIP Sync technology and time synchronization.
PhaseManager™ User Manual, publication LOGIX-UM001	Describes how to build and program a Logix5000 controller to use equipment phases.
EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001	Describes Ethernet network considerations, networks, and setting IP addresses.
ControlLogix Controller User Manual, publication 1756-UM001	Describes the necessary tasks to install, configure, program, and operate a ControlLogix system.
GuardLogix Controllers User Manual, publication 1756-UM020	It describes the GuardLogix-specific procedures you use to configure, operate, and troubleshoot your controller.
Kinetix 6200 and Kinetix 6500 Modular Servo Drive User Manual, publication 2094-UM002	Provides information on installing, configuring, start up, troubleshooting, and applications for the Kinetix 6200 and Kinetix 6500 servo drive systems.
Kinetix 350 Single-axis EtherNet/IP Servo Drive User Manual, publication 2097-UM002	Provides detailed information on wiring, power, troubleshooting, and integration with ControlLogix, or CompactLogix controller platforms.
Kinetix 5500 Drives Installation Instructions, publication 2198-IN001	Provides installation instructions for the Kinetix 5500 Integrated Axis Module and Axis Module components.
Kinetix 5500 Servo Drives User Manual, publication 2198-UM001	Provides information on installing, configuring, start up, troubleshooting, and applications for the Kinetix 5500 servo drive systems.
Kinetix 5700 Multi-axis Servo Drives User Manual, publication 2198-UM002	Provides information on installing, configuring, start up, troubleshooting, and applications for the Kinetix 5700 servo drive systems including the Dual Axis Inverter, High Power Inverter, and the Diode Front End modules.

Table 2 - Publications About Related Products (Continued)

Resource	Description
PowerFlex 750-Series AC Drives Reference Manual, publication 750-RM002	Provides detailed drive information including operation, parameter descriptions, and programming of the AC drive.
PowerFlex 750-Series AC Drives Programming Manual, publication 750-PM001	Provides information that is needed to install, start-up, and troubleshoot PowerFlex 750-Series Adjustable Frequency AC Drives.
PowerFlex 755 Drive Embedded EtherNet/IP Adapter User Manual, publication 750COM-UM001	Provides information on installing, configuring, start up, troubleshooting, and applications for the PowerFlex 755 Drive Embedded EtherNet/IP Adapter.
Integrated Motion Encoder on EtherNet/IP User Manual, publication 842E-UM002	Provides information on how to install, configure, diagnose the 842E-CM Integrated Motion Encoder.
GuardLogix Controllers User Manual, publication 1756-UM020	Provides information on configuring and programming the 1756 GuardLogix® controller.
GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093	Contains detailed requirements for achieving and maintaining SIL 3 with the GuardLogix controller system.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.
Network specifications details, http://www.odva.org	ODVA is the organization that supports network technologies that are built on the Common Industrial Protocol (CIP) — DeviceNet, EtherNet/IP, CompoNet, and ControlNet.

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Configure Integrated Motion Control Using Kinetix Drives

This chapter provides procedures on how to configure integrated motion control by using the Kinetix 350, Kinetix 5500, and Kinetix 6500 drives. The basic configuration for an integrated motion solution is to associate a drive with motor feedback and an axis configuration type.

For the examples in this chapter, the Kinetix 6500 drive is used and the exceptions for the Kinetix 350, Kinetix 5500 drives noted. For the Kinetix 5700 drive, see the Kinetix 5700 Multi-axis Servo Drives User Manual, publication 2198-UM002. Although, the Kinetix 5700 drive is included in several tables, for example, Compare the Axis Configuration Types for the Drives on page 32.

Topic	Page
Configuring a Kinetix Drive	20
Add a Kinetix EtherNet/IP Drive	20
Create an Associated Axis	24
Configuring the General Parameters	28
Create a Motion Group	34
Specifying the Motor Data Source	39
Display Motor Model Information	42
Assign Motor Feedback	43
Configuring the Load Feedback	44
Configuring the Master Feedback	45
Create Reports	45

For information about what attributes are replicated in the drive, see the Integrated Motion on the EtherNet/IP network Reference Manual, publication MOTION-RM003.

For complete information on how to configure a drive with integrated safety connections, see the Kinetix 5500 Servo Drives User Manual, publication2198-UM001.

Configuring a Kinetix Drive

After you add the drive to your project, use software dialog boxes to configure the drive. As you configure a drive, notice that the dialog boxes change based on your configuration choices, for example, feedback configuration.

This table provides you with the basic tasks needed to configure a drive.

Table 3 - Category Dialog Boxes to Configure Kinetix Drive

Category Dialog Box	Perform These Tasks	Page
General	• Assign the axis configuration. • Choose the feedback configuration. • Choose the application type, if applicable. • Choose the loop response (low, medium, or high), if applicable. • Create and associate an axis to a new Motion Group. • Associate a drive module to the axis.	28
Motor	• Specify a motor with the Data Source = Nameplate Datasheet. • Specify a motor with the Data Source = Catalog Number. • Select a motor with the Data Source = Motor NV.	39
Motor Feedback	• Connect the Motor Feedback cable. • Select the Motor Feedback Type.	43
Load Feedback	• Select the Load Feedback Type, if applicable.	44
Scaling	• Configure feedback by choosing the load type, entering the scaling units, and choosing the Travel mode. • Enter the Input Transmission and Actuator ratio, if applicable.	146

Add a Kinetix EtherNet/IP Drive

Follow these instructions to add a Kinetix drive your project.

IMPORTANT To configure 2198-H*xxx*-ERS (hardwired safety) drives, you must use the Logix Designer application, version 21.00 or later.

To configure 2198-H*xxx*-ERS2 (integrated safety) drives, you must use the Logix Designer application, version 24.00 or later.

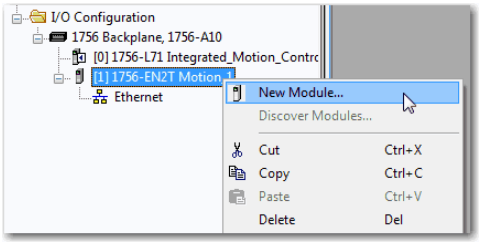
To configure the Kinetix 5700 Multi-axis Servo drive and associated inverter and diode modules, you must use the Logix Designer application, version 26.00 or later. The configuration of the Kinetix 5700 drive is considerably different than the other drives, be sure to reference the Kinetix 5700 Multi-axis Servo Drives User Manual for all configuration information.

- For complete information about configuring Kinetix 5700 Multi-axis Servo Drives User Manual, publication 2198-UM002.
- For complete information about configuring Kinetix 350 Single-axis EtherNet/I/P Servo Drive User Manual, publication 2097-UM002.
- For complete information about configuring Kinetix 5500 Servo Drives, see the Kinetix 5500 Servo Drive User Manual, publication 2198-UM001.
- For complete information about configuring Kinetix 6500 drive, see the Kinetix 6500 Modular Multi-axis Servo Drives User Manual, publication 2094-UM002.

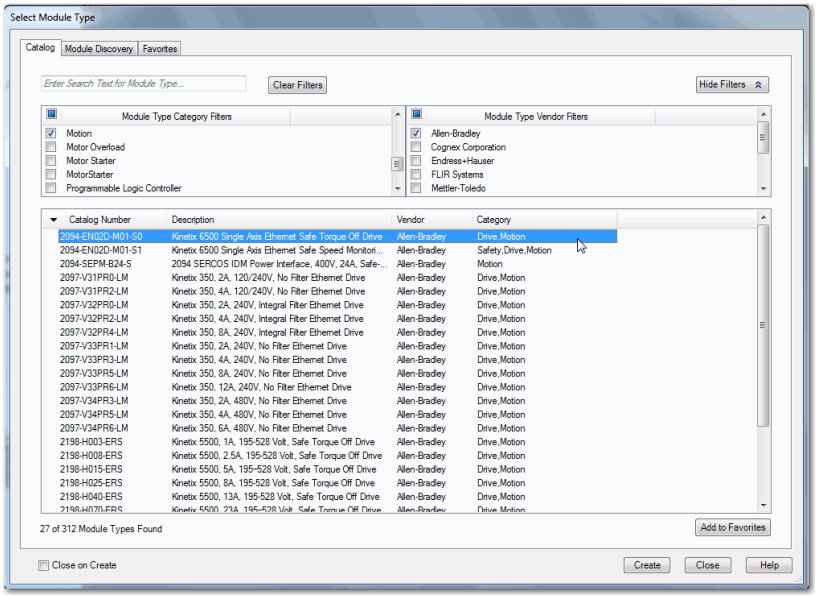
TIP When you add drive modules for a sercos network, you see the power structures and catalog numbers. With integrated motion, you assign the power structure later in the configuration process.

See Assign the appropriate Power Structure. on page 23.

1. Right-click the Ethernet network (node) and choose New Module.

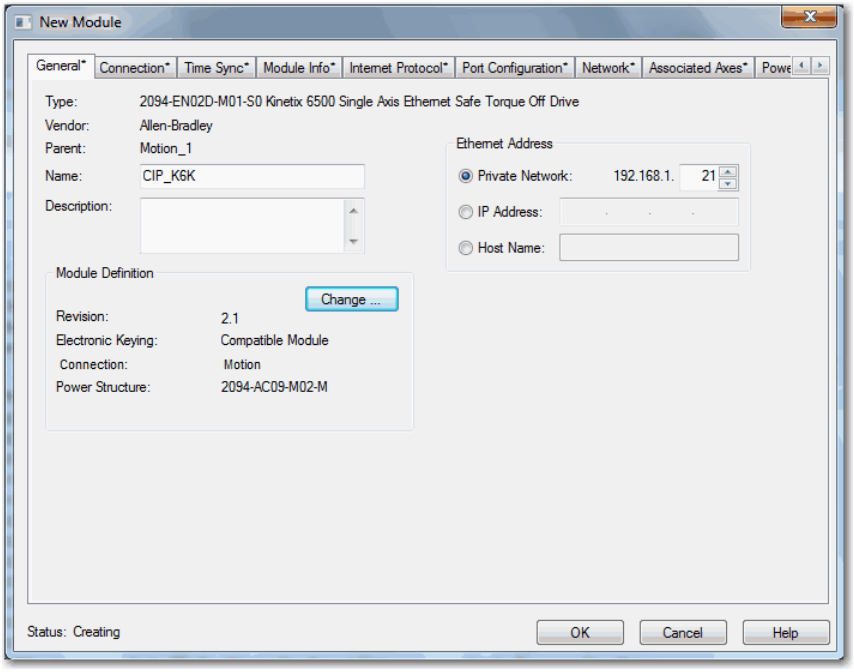


2. Check the Motion checkbox to filter the selections and choose the Kinetix 350, Kinetix 5500, or a Kinetix 6500 drive.



3. Click Create.

4. Type a Name for the module.

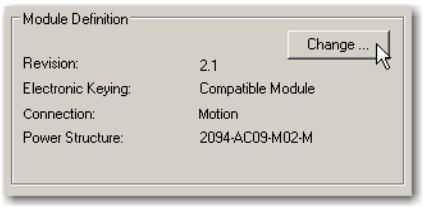


5. Type a description, if desired.
6. Assign an EtherNet/IP address.

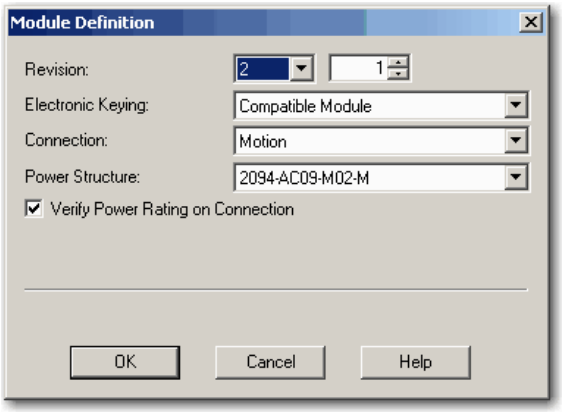
   For Private Network segments, you can establish the Node Address of the drive by entering a private IP address via a thumbwheel switch on the drive, using the format 192.168.1.xxx, where the last octet, xxx, is the switch setting.

   See the EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001, for information on setting IP addresses and other Ethernet network considerations.

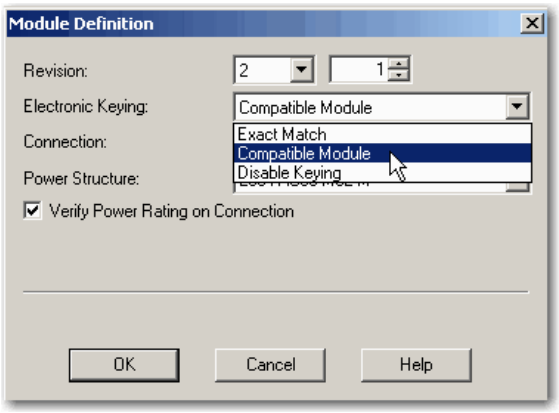
7. Under Module Definition, click Change.



The Module Definition dialog box appears.



8. Choose an Electronic Keying option.



ATTENTION: The electronic keying feature automatically compares the expected module, as shown in the configuration tree, to the physical module before communication begins.
When you are using motion modules, set the electronic keying to either `Exact Match' or `Compatible Keying'.

Never use `Disable Keying' with motion modules.

For more information about electronic keying see the ControlLogix Controller User Manual, publication 1756-UM001.

9. Assign the appropriate Power Structure.

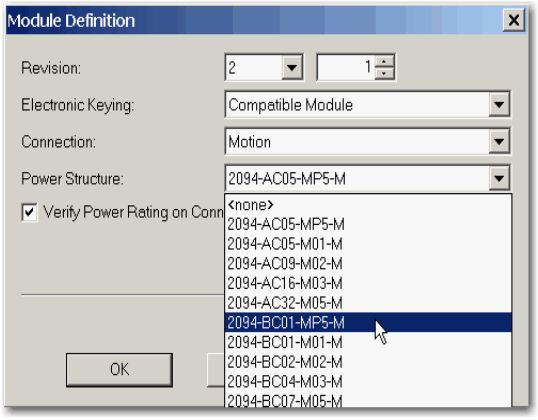
When you select a Kinetix 6500 drive catalog number, you are specifying only a class of drives. To specify the drive, you must assign a power structure. Some of the drives do not require a power structure.

TIP You can locate the power structure reference numbers by doing the following.

- Checking the hardware
- Referring to the device documentation
- Reviewing the purchase order or the bill of materials.

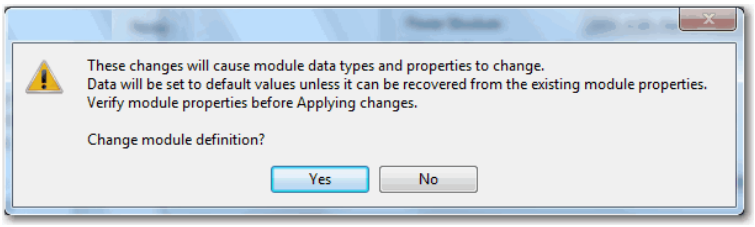
You assign the power structure for the Kinetix 6500 drive only. The Kinetix 350 and Kinetix 5500 drives auto-populate the only power structure available.

10. Check the checkbox if you want to verify the power rating on connection.



11. Click OK.

When you change the Module Definition, related parameters also change. Changing the major revision or power structure changes the identity of the drive. If your drive is associated to an axis, these changes disassociate the axis.


These changes will cause module data types and properties to change.
Data will be set to default values unless it can be recovered from the existing module properties.
Verify module properties before Applying changes.
Change module definition?
Yes
No

12. On the General tab, click OK to apply the changes.

TIP If you go to the Associated Axis tab before you click OK and exit the General tab, the option to create or associate an axis is unavailable. Once you exit, you can return to the Associated Axis tab and create an axis or associate an existing axis. Alternatively, you can create an axis by right-clicking the Motion Group in the Controller Organizer tree.

Create an Associated Axis

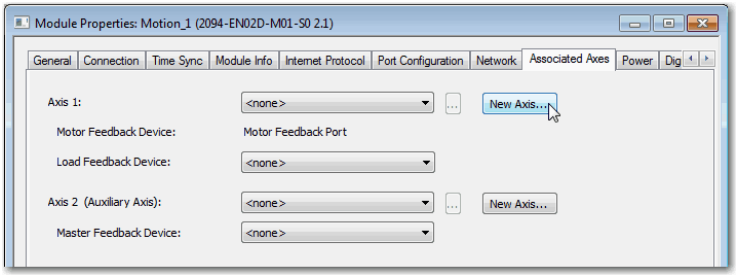
There are two approaches that you can take to create and configure an axis. You can create an axis first and then add the axis to your motion group or you can create your motion group and then add an axis.

The procedure that is outlined in this section takes the approach to create your axis first, configure the axis, and then add it to your motion group.

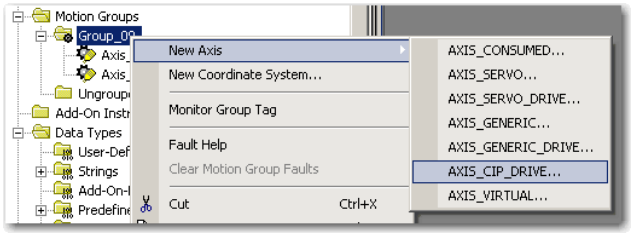
Create an Axis for a Kinetix Drive

Follow these steps to create an axis.

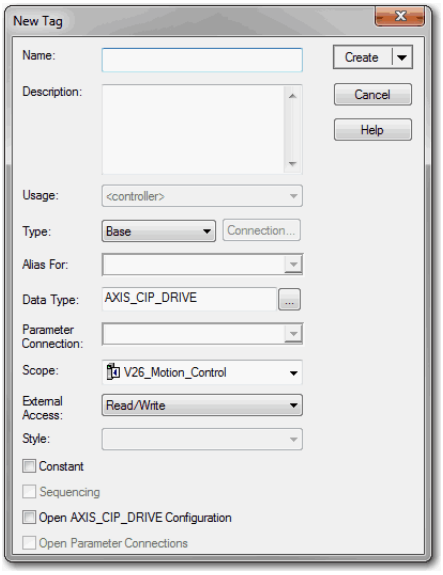
1. Double-click the drive in the Controller Organizer to open the Module Properties dialog box.
2. Click the Associated Axes tab.
3. Click New Axis.



TIP You can create an axis directly off the Associated Axis dialog box in the drive Module Properties dialog box, or by right-clicking the Motion Group and choosing New Axis.



The New Tag dialog box appears.

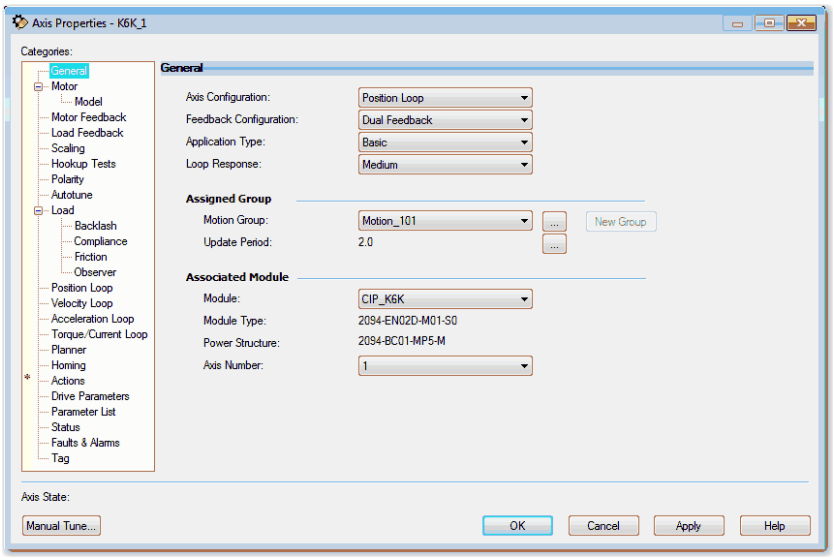


Notice that the fields in the next steps are automatically entered for the AXIS_CIP_DRIVE data type.

4. Type a Tag name.
5. Type a Description, if desired.
6. Choose the Tag Type.
7. Choose the Data Type AXIS_CIP_DRIVE.
8. Choose the Scope.
9. Choose the External Access.

   For more information about External Data Access Control and Constants, see the Logix5000 Controllers I/O and Tag Data Programming Guide, publication 1756-PM004.
10. Click Create.

If you have checked Open AXIS_CIP_DRIVE Configuration, then the General dialog box of the Axis Properties appears. If not, double-click the axis in the Controller Organizer.



Establish Feedback Port Assignments

The Kinetix 6500 drive has two feedback ports. Port 1 is reserved for Motor Feedback on the primary axis (Axis_1). Port 2 can be used either as Load Feedback for the primary axis or as Master Feedback associated with a secondary feedback only axis (Axis_2).

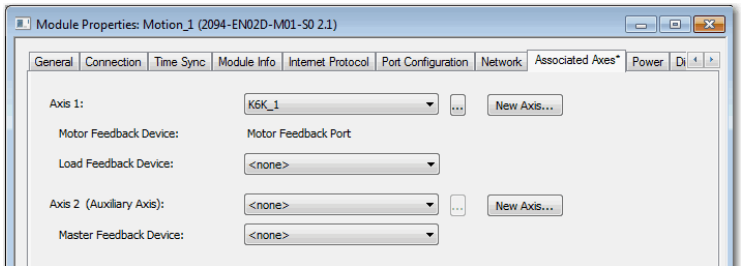
See Configuration Examples for a Kinetix Drive on page 99.

Example Primary Axis Configuration

Follow these steps to associate axes to the Kinetix module.

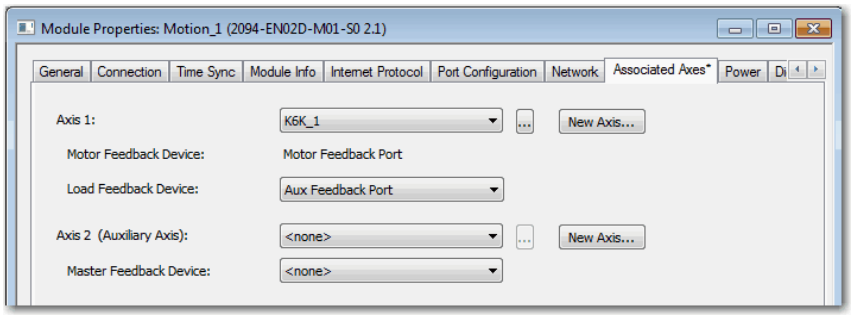
1. Double-click the Kinetix 6500 drive in the Controller Organizer to go to Module Properties.
2. Click the Associated Axes tab.

   Notice that the motor feedback is already configured by default.



   The AUX Feedback Port (Port 2) of the drive can be optionally used for load feedback of the primary axis (Axis 1) to support Load or Dual Feedback Configuration.

3. From the Load Feedback Device pull-down menu, choose AUX Feedback Port.



Configuring the General Parameters

The parameters that you configure on the General dialog box result in the presentation of attributes and parameters that are available for the combination of your selections.

IMPORTANT	All AXIS_CIP_DRIVE Axis Properties dialog boxes are dynamic. Optional attributes and dialog boxes that are related to each integrated motion axis you create come and go based on what combination of axis characteristics you define.

Axis attributes are either required, optional, or conditional based on the selected control mode. The Axis Attribute you use determines internally the usage definition.

See the Integrated Motion Reference Manual, publication MOTION-RM003, for complete information on Axis Attributes and how to apply Control Modes.

On the General dialog box, you can modify these parameters:

- Associate a drive module to the axis.
- Select the axis configuration.
- Choose the feedback configuration.
- Choose the application type, if applicable.
- Choose the loop response, if applicable.
- Create and associate a new motion group.

Optional attributes are dependent on the associated drive characteristics.

IMPORTANT	Be sure to associate the drive as the first step in configuring the axis because the drive determines what optional attributes are supported.

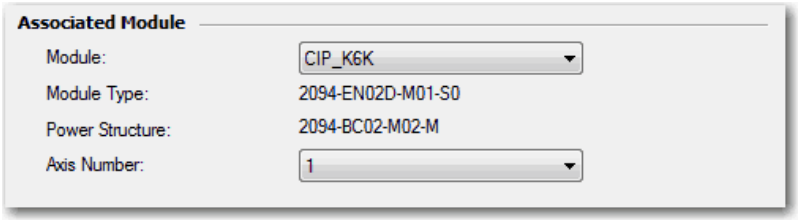
Associate Axes and Drives

The two ways to establish the drive/axis associations are:

- The first way is to assign the drive to the axis on the Associated Axis tab in the Module Properties dialog box.
- The second way is to assign the axis to the drive on the General dialog box for the axis.

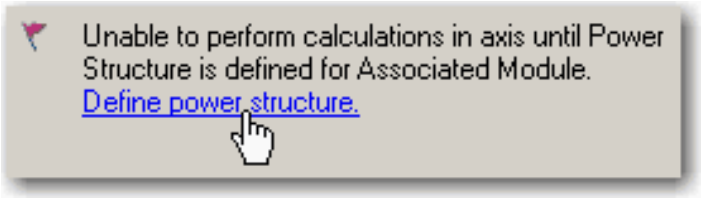
Follow these steps on the General dialog box and the Module Properties dialog box to associate the axis to a drive module and to map the drive to the axis.

1. Go to the General dialog box for the axis.
2. Choose the drive module that you want the axis to be associated with.



3. Leave the Axis Number as 1, the default.

   When you select a Kinetix 6500 drive, the drive catalog and the power structure you assigned appears. If you have not assigned a power structure, this message appears The Kinetix 350 and the Kinetix 5500 drives do not require a power structure, so this message does not appear.


Unable to perform calculations in axis until Power Structure is defined for Associated Module.
Define power structure.

If you are using a Kinetix 6500 drive, click the hyperlink to go to the Module Properties dialog box for the drive to assign a Power Structure.

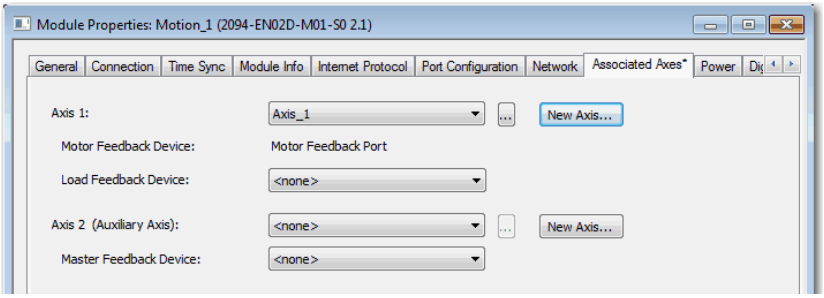
   This message means that without fully defining the drive with a power structure, the factory defaults cannot be computed.

See Assign the appropriate Power Structure. on page 23.

Map a Kinetix Drive to the Axis

Follow this instruction to map a Kinetix drive.

1. Go the Module Properties dialog box of the drive.
   - Right-click the module in the I/O tree and choose Properties.
   - Double-click the module in the I/O tree.
   - Right-click the axis in the Controller Organizer and choose Go to Module.
2. Go to the Associated Axis tab.



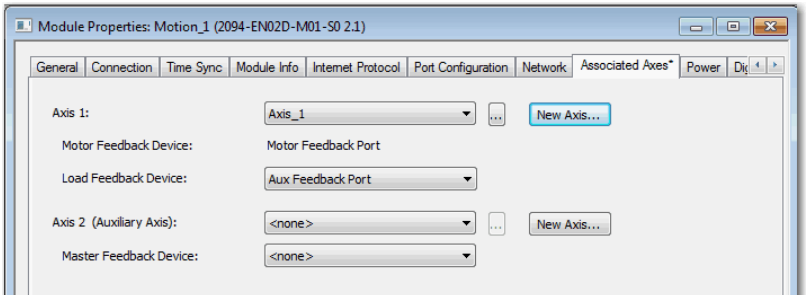
   Axis 1 on the Associated Axes tab in Module Properties corresponds to Axis 1 listed on the General dialog box in the Axis Properties: see step 2 on page 29.

   The axis tag field appears as Axis 1, for example, Axis_I_Position_Motor. The Motor/Master Feedback Device (Motor Feedback Port) is populated based on the Feedback Configuration type.

3. Choose the Load Feedback device.

   This selection maps the second port of the Kinetix 6500 drive as the input port for the Dual (or Load) feedback device.

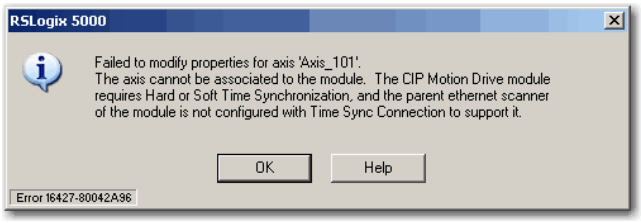
   For the Axis Configuration type, Position Loop and Feedback Configuration type, Dual (or Load) Feedback, see Example 2: Position Loop with Dual Feedback on page 103.



   For more detailed examples, see Configuration Examples for a Kinetix Drive on page 99.

4. Click OK.

The changes are applied the Module Properties dialog box closes. If you have not enabled Time Synchronization, this message appears.


RSLogix 5000
Failed to modify properties for axis 'Axis_101'.
The axis cannot be associated to the module. The CIP Motion Drive module requires Hard or Soft Time Synchronization, and the parent ethernet scanner of the module is not configured with Time Sync Connection to support it.
OK
Help
Error 16427-80042A96

You must go to the 1756-EN*x*T Communication Module Properties and enable time synchronization.

See Add a 1756-ENxTx Communication Module on page 95 for more information.

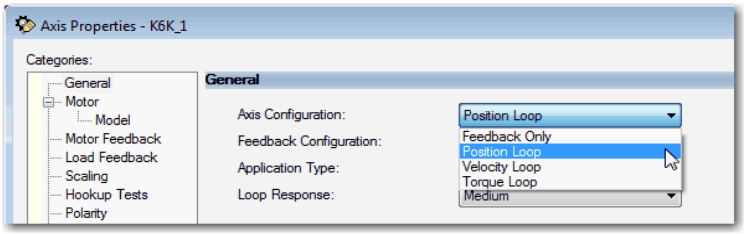
Configure the Associated Axis and Control Mode

Now that the axis is associated to the drive module, meaningful values are available for other axis properties.

For more information on Control Modes, see the Integrated Motion Reference Manual, publication MOTION-RM003.

1. In the Controller Organizer, double-click the Axis that you want to configure.

   The Axis Properties General dialog box appears.



2. Choose an Axis Configuration type. For this example, choose Position Loop.

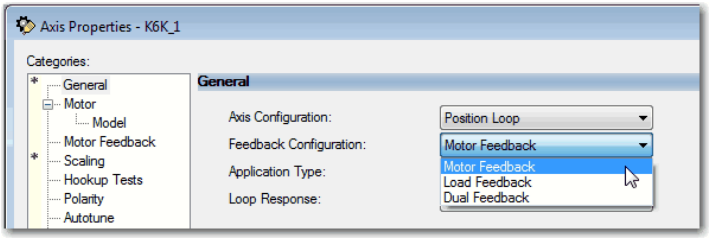
   TIP The associated drive determines what Axis and Feedback Configuration choices are presented.

This table compares the axis configuration types for the drives.

Table 4 - Compare the Axis Configuration Types for the Drives

Axis Type	Loop Type	Kinetix 350	Kinetix 5500	Kinetix 5700	Kinetix 6500	PowerFlex 755
Position Loop	P	Yes	Yes	Yes	Yes	Yes
Velocity Loop	V	Yes	Yes	Yes	Yes	Yes
Torque Loop	T	Yes	Yes	Yes	Yes	Yes
Feedback Only	N	No	No	Yes	Yes	No
Frequency Control	F	No	Yes	Yes	No	Yes

3. In the Feedback Configuration drop down, choose Motor Feedback.



TIP The Kinetix 350, Kinetix 5500, and Kinetix 5700 drives support only Motor Feedback.

This table compares the feedback configuration types for the Kinetix drives.

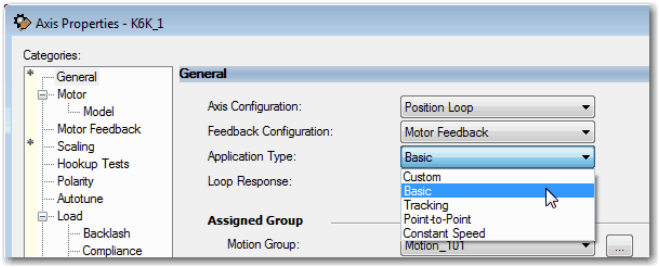
Table 5 - Compare the Feedback Configuration Types for the Drives

Feedback Type	Loop Type	Kinetix 350	Kinetix 5500	Kinetix 5700	Kinetix 6500	PowerFlex 755
Motor Feedback	P, V, T	Yes	Yes	Yes	Yes	Yes
Load Feedback	P, V, T	No	Yes	No	Yes	Yes
Dual Feedback	P	Yes	Yes	No	Yes	Yes
Dual Integrator	P	No	No	No	No	No
Master Feedback	N	No	No	No	Yes	No
No Feedback	V, F	No	No	No	No	Yes

Table 6 - Kinetix 5700 Feedback Summary

Kinetix 5700 Inverter	Inverter Cat. No.	Motor Feedback	Auxiliary Feedback
Single-axis Inverters	2198-Sxxx-ERS3	1 (axis 1)	1 (axis 2)
Dual-axis Inverters	2198-Dxxx-ERS3	2 (axis 1 and 3)	2 (axis 2 and 4)

4. Choose an Application Type, if applicable.



TIP Application Type defines the servo loop configuration automatically. These combinations determine how the calculations are made that can eliminate the need for you to perform an Autotune or a Manual Tune.

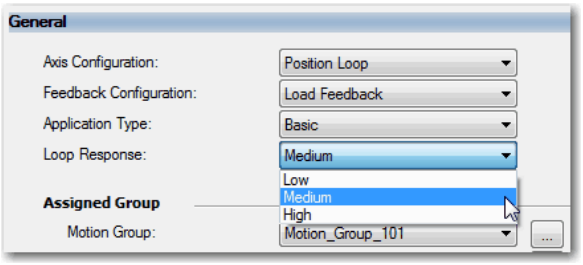
The Application Type determines the type of motion control application. This attribute is used to set the Gain Tuning Configuration Bits. This table illustrates the gains established based on application type.

Table 7 - Customize Gains to Tune

Application Type	Kpi	Kvi	ihold	Kvff	Kaff	torqLPF
Custom(1)	-	-	-	-	-	
Basic (V20 and later)	No	No	No	Yes	No	Yes
Basic (V19 and earlier)	No	No	No	No	No	-
Tracking	No	Yes	No	Yes	Yes	Yes
Point-to-Point	Yes	No	Yes	No	No	Yes
Constant Speed	No	Yes	No	Yes	No	Yes

(1) If you set the type to Custom, you can control the individual gain calculations by changing the bit settings in the Gain Tuning Configuration Bits Attribute.

5. Choose a Loop Response, if applicable.



TIP Loop Response settings also impact the calculations that are made that can eliminate the need for you to perform an Autotune or a Manual Tune.

Create a Motion Group

All axes must be added to the Motion Group in your project. If you don't group the axes, they remain ungrouped and unavailable for use. You can only have one Motion Group per Logix controller.

You can have eight Position Loop axes per 1756-EN2T module. Each drive requires one TCP and one CIP connection. If you have other devices that consume TCP connections on the module, it reduces the number of drives you can support.

Table 8 - Position Loop Configured Axes

Controller	Communication Modules	Supported Axes(1)		
		Position Loop(2)	Other Loop Types	Integrated Motion Drives(3)
1756-L6*x* and L7*x*	1756-EN2T and 1756-EN2TF	8	Up to 100	
1756-L6*x* and L7*x*	1756-EN3TR	100	Up to 100	
	1756-EN2TR	8	Up to 100	
1769-L18ERM	Embedded Ethernet	2	Up to 100	8 max nodes
1769-L27ERM	Embedded Ethernet	4	Up to 100	16 max nodes
1769-L30ERM	Embedded Ethernet	4	Up to 100	16 max nodes
1769-L33ERM	Embedded Ethernet	8	Up to 100	32 max nodes
1769-L36ERM	Embedded Ethernet	16	Up to 100	48 max nodes

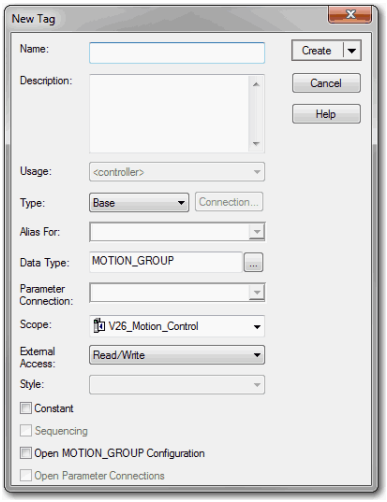
(1) Multiple controllers can control drives on a common 1756-EN*x*T*x* module, so based on the TCP connection limit, up to 128 can be supported.

(2) Only the drives/axes configured for Position Loop are limited. Frequency Control, Velocity Loop, and Torque Loop configured drives/axes are not limited.

(3) If more than the maximum I/O modules are configured in the I/O tree under Embedded Ethernet, then you get a Project Verify Error: Error: Maximum number of nodes on the local Ethernet port has been exceeded.

Follow these instructions to create a motion group.

1. Click New Group.

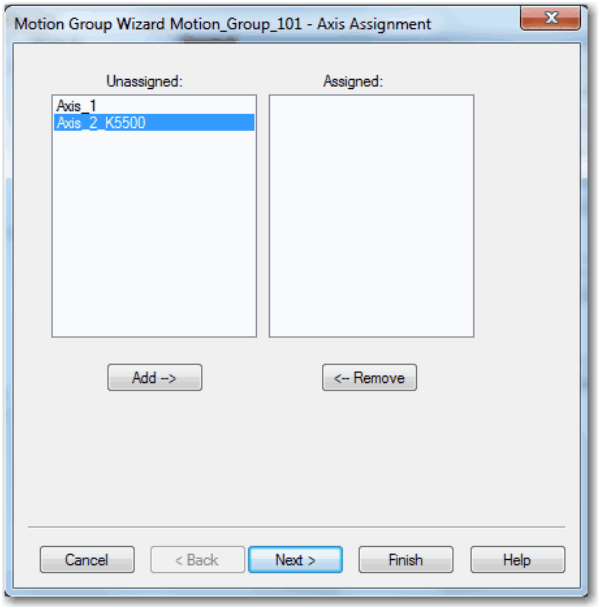


2. Type a Tag name.
3. Type a description, if desired.
4. Choose the Tag Type.

5. Choose a Data Type of MOTION-GROUP.
6. Choose the Scope.
7. Choose the External Access.

   For more information about External Data Access Control and Constants, see the Logix5000 Controllers I/O and Tag Data Programming Guide, publication 1756-PM004.
8. Check Open MOTION_GROUP configuration and click Create.

   The Motion Group Properties dialog box appears.



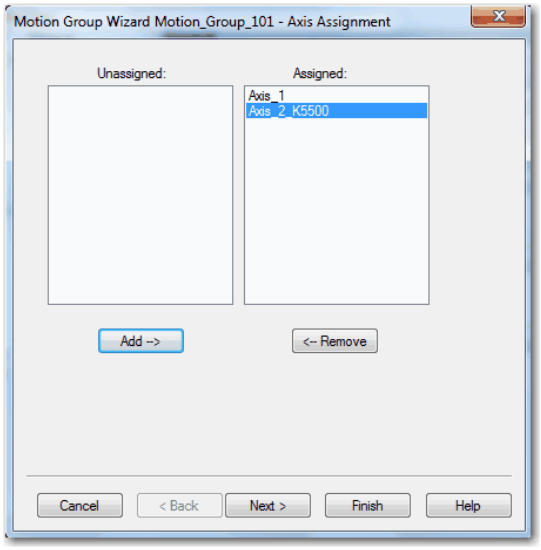
Associate the Axis to the Motion Group

There are two ways to assign axes to a Motion Group:

- Create a motion group through the Axis Assignment tab on the Motion Group Properties dialog box.
- Drag the axis into the Motion Group in the Controller Organizer tree.

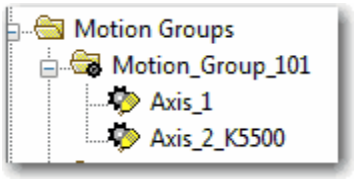
Follow these instructions to associate an axis to the Motion Group.

1. Select an axis and click Add.
2. Verify that the axis has been assigned to the group.



3. Click Finish.

   The axis appears under the Motion Group in the Controller Organizer tree.



Set the Base Update Period

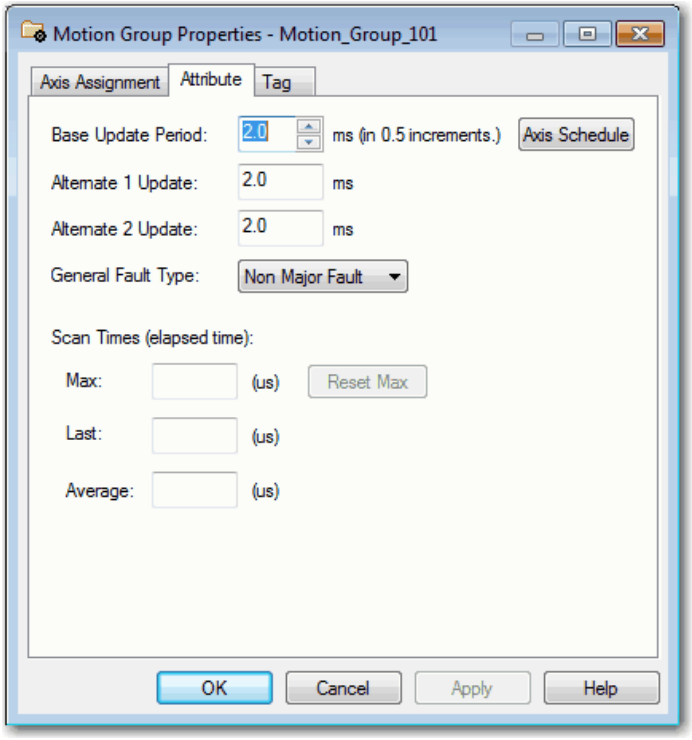
The Base Update Period is basically the RPI rate for Ethernet communication between the controller and the motion module, a Unicast connection.

There are two alternate update periods that you can configure when using the Axis Scheduling function. See Configure Axis Scheduling on page 77 for details.

The Base Update Period determines how often the Motion Task runs. When the Motion Task runs, it interrupts most other tasks regardless of their priority. The Motion Task is the part of the controller that takes care of position and velocity information for the axes.

Follow these steps to set the Base Update Period.

1. Click the Attribute tab in the Motion Group Properties dialog box.

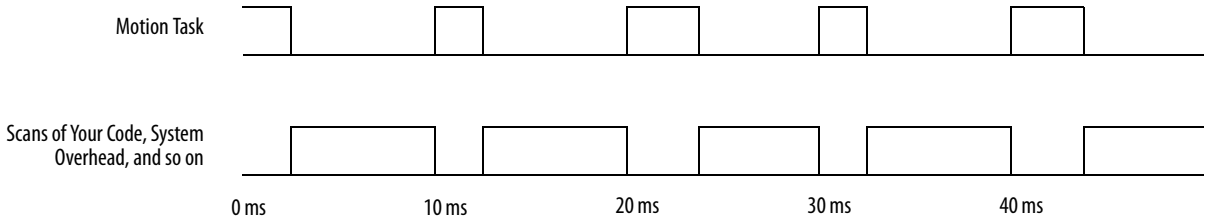


2. Set the Base Update Period to 2.0...32.0 ms.

TIP Check the Last Scan time values. Typically, the value is less than 50% of the Base Update Period.

For the Kinetix 6500 drive, the minimum Base Update Rate is 1 ms.

Figure 1 - Base Update Period Example



In this example, the Base Update Period = 10 ms. Every 10 ms the controller stops scanning your code and whatever else it is doing and runs the motion planner.

The Base Update Period is a trade-off between updating positions of your axes and scanning your code. In general, you do not want the Motion Task to take more than 50% of the overall Logix controller time on average. The more axes that you add to the Motion Group, the more time it takes to run the Motion Task.

For a 1756-L6x controller, the incremental impact on the Motion Task is roughly 2...3 drives/ms. For the 1756-L7x controller, the incremental impact on the Motion Task is roughly at 6...8 drives/ms. Actual impact can vary depending on axis configuration.

For detailed information on the Axis Scheduling function, Axis Assignment tab, and Alternate Update Period Scheduling, see Configure Axis Scheduling on page 77.

Integrated Architecture Builder

To help you determine motion system performance, use the motion performance calculator in the Integrated Architecture Builder (IAB).

The IAB is a graphical software tool for configuring Logix-based automation systems. It helps you select hardware and generate bills of material for applications that include controllers, I/O, networks, PowerFlex drives, On-Machine cabling and wiring, motion control, and other devices.

You can find the software at
http://www.rockwellautomation.com/en/e-tools/configuration.html

Specifying the Motor Data Source

The Motor Data Source is where you tell the axis where the motor configuration values are originating. You can select a motor by catalog number from the Motion Database. You can enter motor data from a nameplate or datasheet, or use the motor data that is contained in the drive or motor nonvolatile memory.

On the Motor dialog box you specify what motor you want to use and where the data is coming from:

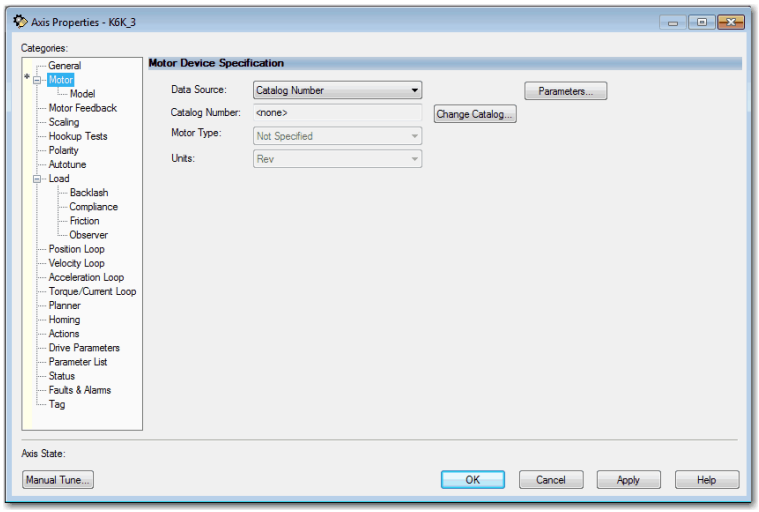
- Specify a motor with the Data Source = Nameplate Datasheet.
- Specify a motor with the Data Source = Catalog Number.
- Select a motor with the Data Source = Motor NV.

Choose the Catalog Number

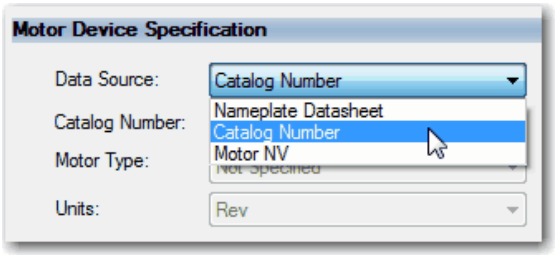
Follow these steps to choose a motor from the Motion Database.

1. If the Axis Properties dialog box is not open, double-click the axis.
2. Go to the Motor dialog box of Axis Properties.

The asterisk next to a category means that you have not applied changes.

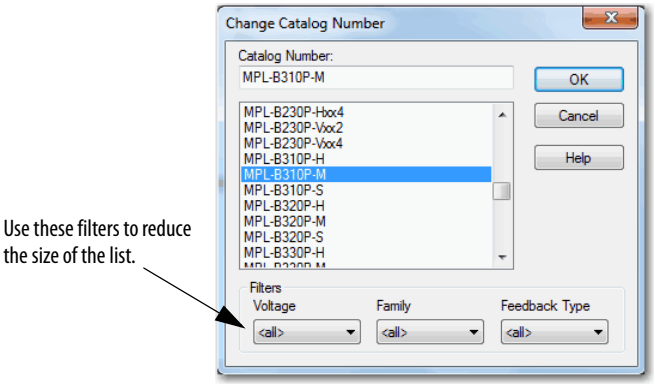


3. From the Data Source pull-down menu, choose Catalog Number.

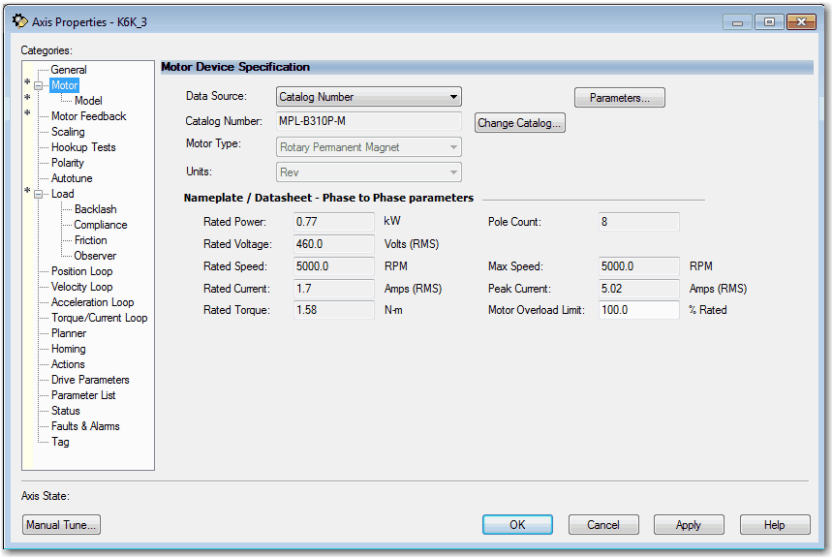


4. Click Change Catalog.

5. Select a motor.



The Motor dialog box is now populated with all information related to the motor you selected from the Motion Database.



6. Click Apply.

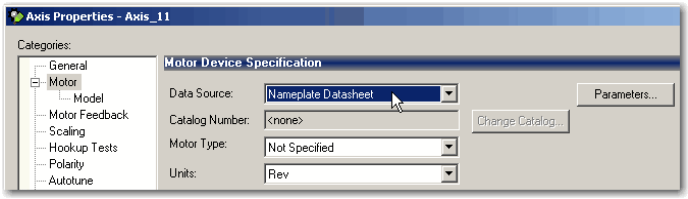
TIP When you use a motor catalog number as the data source, default values, for example, gains and dynamics, are automatically set based on the Application Type and Loop Response settings from the General dialog box.

The defaults minimize the need for Autotune, Manual Tune, and the manual setting of these parameters.

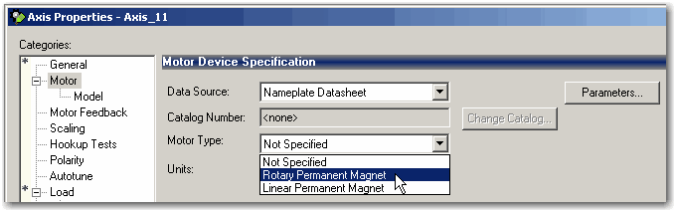
Choose Nameplate

The Nameplate option requires you to enter the motor specification information from the motor nameplate and the motor datasheet.

1. On the Motor dialog box of Axis Properties, from the Data Source pull-down menu, choose Nameplate Datasheet.



2. Choose a motor type.

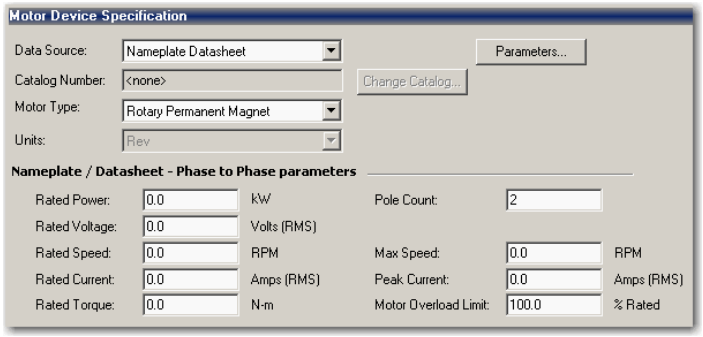


This table illustrates the motor types and drives that are compatible.

Table 9 - Compatible Motor Types

Motor Type	Kinetix 350	Kinetix 5500	Kinetix 5700	Kinetix 6500	PowerFlex 755
Rotary Permanent Magnet	Yes	Yes	Yes	Yes	Yes
Linear Permanent Magnet	No	No	Yes	Yes	No
Rotary Induction	No	Yes	Yes	No	Yes

Notice that the motor information fields are initialized to defaults.

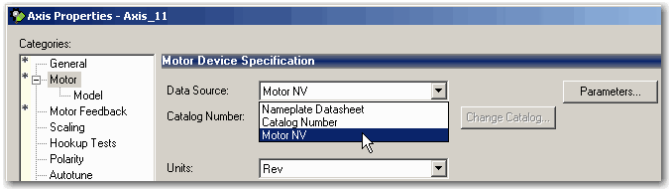


3. Enter the parameter information from the motor Nameplate Datasheet and click Apply.

Choose Motor NV

When you choose Motor NV as the data source, the motor attributes are derived from nonvolatile memory of a motor-mounted smart feedback device that is equipped with a serial interface. Only a minimal set of motor and motor feedback (Feedback 1) attributes are required to configure the drive.

1. From the Motor dialog box of Axis Properties, choose Motor NV.



2. Choose the Motor Units that are associated with the motor, either Rev for rotary motor or Meters for linear motor.

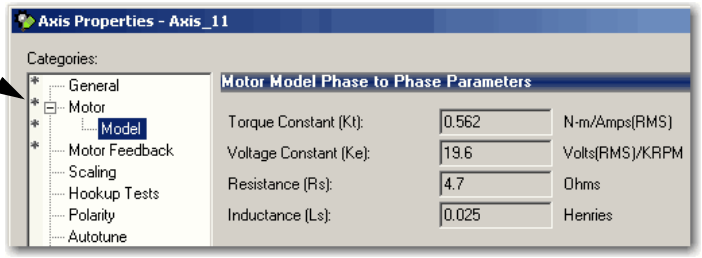
   No other motor information is needed.

3. Click Apply.

Display Motor Model Information

The Motor Model dialog box displays more information that is based on the motor type you select.

The asterisk next to a category means that you have not applied changes.



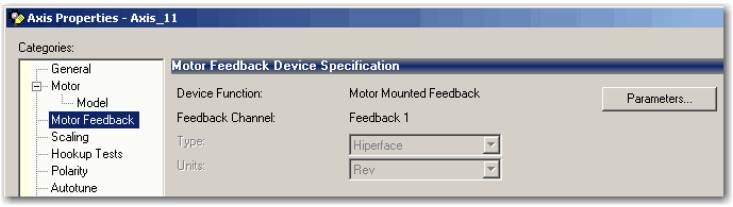
- If the motor data source is Database, this information is populated automatically.
- If the motor data source is Nameplate Datasheet, this information must be entered manually, or by running the optional Motor Analyzer.
- If the motor data source is Motor NV, this dialog box is blank.

Assign Motor Feedback

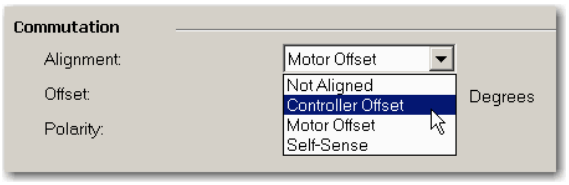
What appears on the Motor Feedback dialog box is dependent on what you select on the General dialog box for Feedback Configuration.

The Motor Feedback dialog box represents the information for the feedback device that is directly coupled to the motor. This dialog box is available if the feedback configuration specified on the General dialog box is anything other than Master Feedback.

If the motor that you select has Catalog Number as the data source, all information on this dialog box with be entered automatically. Otherwise you have to enter the information yourself.



Attributes that are associated with the Motor Feedback dialog box are designated as Feedback 1.



If a permanent magnet motor is selected from the Motion Database, the Commutation Alignment is set to Controller Offset. However, if a permanent magnet motor is specified from Nameplate Datasheet, you must specify the Commutation Alignment method. The default is set to Not Aligned.

Table 10 - Commutation Alignment Settings

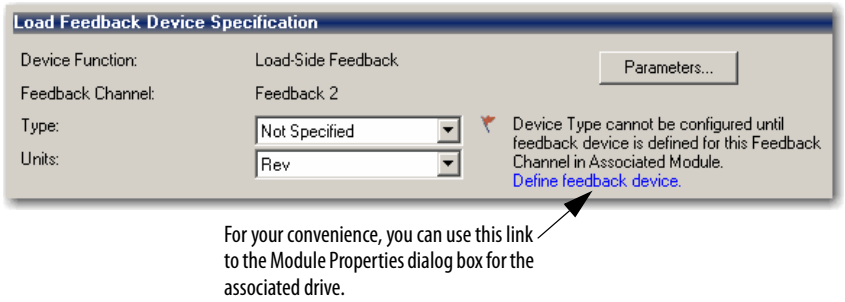
Type	Description
Not Aligned	Not Aligned indicates that the motor is not aligned, and that the Commutation Offset value is not valid. If the Commutation Offset is not valid, the drive cannot use it to determine the commutation angle. Any attempt to enable the drive with an invalid commutation angle results in a Start Inhibit condition.
Controller Offset	Controller Offset applies the Commutation Offset value from the controller to determine the electrical angle of the motor.
Motor Offset	The drive derives the commutation that is offset directly from the motor.
Self-Sense	The drive automatically measures the commutation that is offset when it transitions to the Starting state for the first time after a power cycle. This generally applies to a PM motor equipped with a simple incremental feedback device.

In most cases, the Commutation Alignment is set to Controller Offset and the Commutation test is run during commissioning to determine the Commutation Offset and Polarity.

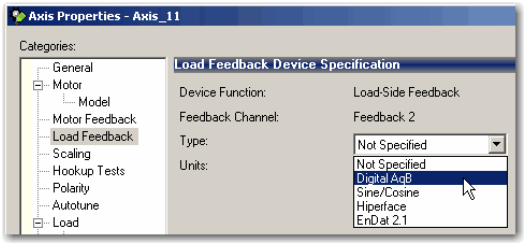
See the Integrated Motion Reference Manual, publication MOTION-RM003, for complete descriptions of the axis attributes.

Configuring the Load Feedback

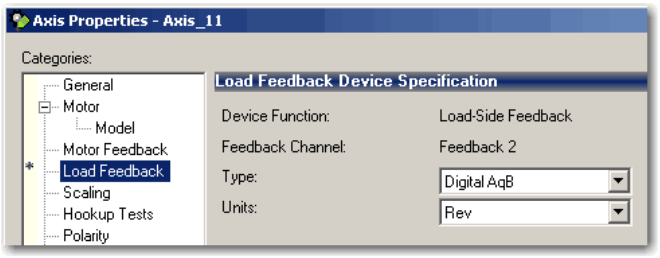
The Load Feedback dialog box contains the information from the feedback device that is directly coupled to the load-side of a mechanical transmission or actuator.


Load Feedback Device Specification
Device Function:
Load-Side Feedback
Parameters...
Feedback Channel:
Feedback 2
Type:
Not Specified
Units:
Rev
Device Type cannot be configured until feedback device is defined for this Feedback Channel in Associated Module.
Define feedback device.
For your convenience, you can use this link to the Module Properties dialog box for the associated drive.

The Load Feedback dialog box is available if the Feedback Configuration specified on the General dialog box is Load or Dual.

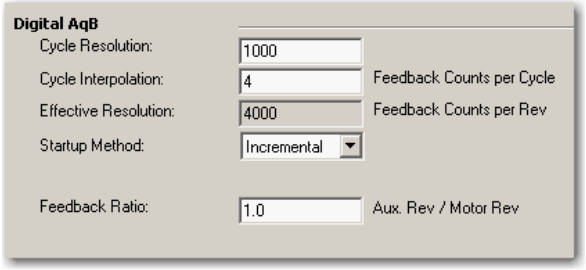


Attributes that are associated with the Load Feedback dialog box are designated Feedback 2.



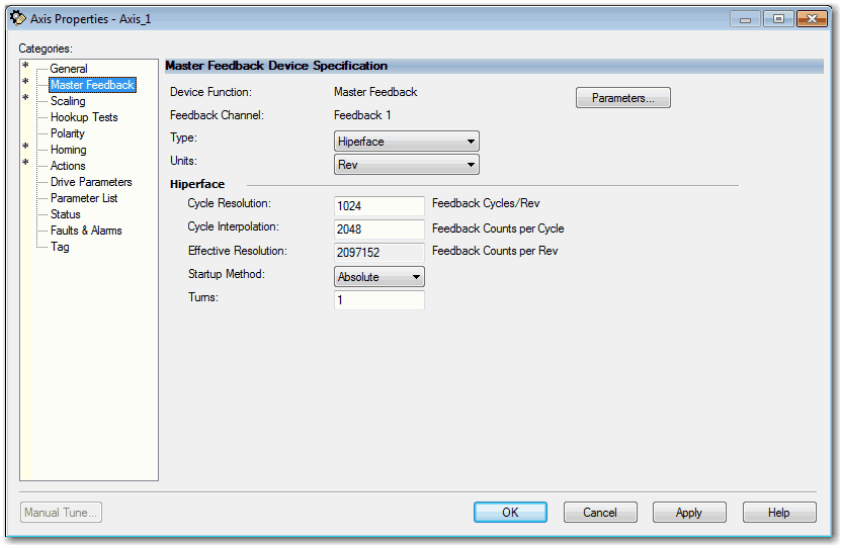
Unlike the Motor Feedback dialog box, you must explicitly enter load feedback device information on the Load Feedback dialog box, including the Feedback Type. This is because the Load Feedback device is not built into the motor.

Default values are displayed based on the Feedback Type selected.



Configuring the Master Feedback

The Master Feedback dialog box is available if the Feedback Configuration specified on the General dialog box is Master Feedback. The attributes that are associated with the Master Feedback dialog box are associated with Feedback 1. Again, like the Load Feedback dialog box, you must enter all the information.

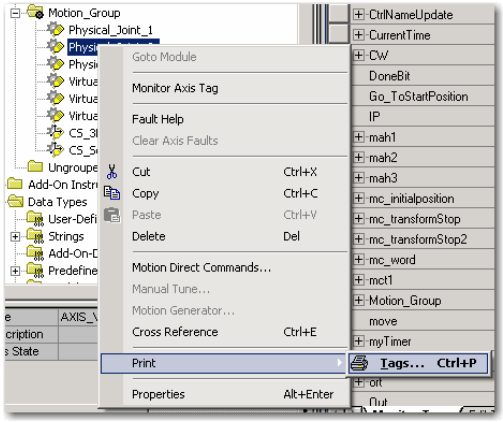


To verify that motor and feedback device are functioning properly, download to the controller, and continue on to Hookup Tests Dialog Box on page 150.

Create Reports

The Logix Designer application lets you print various reports.

1. Right-click Controller Tags, MainTask, MainProgram, Module Properties, Axis, Add-On Instructions, or Data Types and choose Print.



2. On the Print dialog box, select Adobe PDF and click Print Options.

3. Check the Include Special Properties and Advanced list to see all of the information.

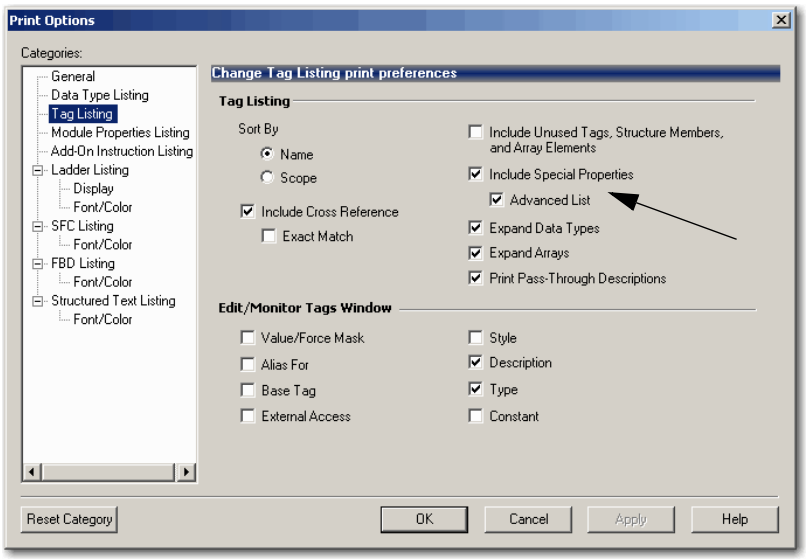
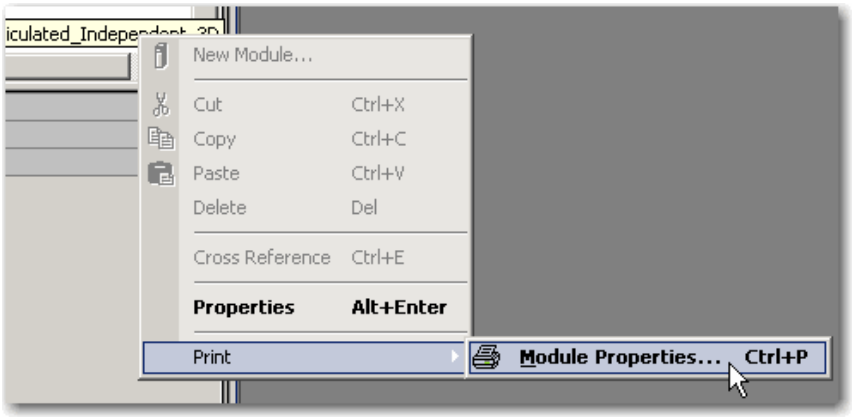


Figure 2 - Axis Tag Report Example

Properties - Motion Axis tag: Axis_II_Position_Dual_loop

General			
Axis Configuration:	Position Loop	Feedback Configuration:	Dual Feedback
Motion Group:	Motion_group_A		
Associated Module			
Module:	K6500_Drive2	Module Type:	2094-EN02D-M01-S0
Power Structure:	2094-AMP5-M	Axis Number:	1
Motor			
Data Source:	Catalog Number	Catalog Number:	MPL-A310P-M
Motor Type:	Rotary Permanent Magnet	Units:	Rev
Nameplate / Datasheet - Phase to Phase parameters			
Rated Power:	0.73 kW	Pole Count:	8
Rated Voltage:	230.0 Volts (RMS)		
Rated Speed:	5000.0 RPM	Max Speed:	5000.0 RPM
Rated Current:	3.43 Amps (RMS)	Peak Current:	9.9 Amps (RMS)
Rated Torque:	1.58 N-m	Motor Overload Limit:	100.0 % Rated

You can also right-click a controller, communication module, and any motion module to print the Module Properties you have configured.



Configure Integrated Motion Using a PowerFlex 755 Drive

This chapter provides procedures on how to configure Integrated Motion on the EtherNet/IP network control by using a PowerFlex 755 Embedded EtherNet/IP drive.

Topic	Page
About the PowerFlex 755 Drives	48
Add a PowerFlex 755 Drive	49
Select a Peripheral Feedback Device and Slot Assignment	51
Assign a Power Structure	52
Create an Axis for a PowerFlex 755 Drive	54
Configure the Associated Axis and Control Mode	59
Create a Motion Group	62
Set the Base Update Period	65
Choose Catalog Number as the Motor Data Source	67
Choose Nameplate as the Motor Data Source	69
Choose Drive NV as the Data Source	70
Feedback Configuration Options for the PowerFlex 755 Drive	73

IMPORTANT When you perform an import/export on a project in the RSLogix 5000 software, version 19 or earlier, the axis absolute position is not recovered on download to the controller.
See Absolute Position Recovery (APR) on page 182.

About the PowerFlex 755 Drives

Integrated Motion on the EtherNet/IP network supports closed loop servo drives and frequency drives. The PowerFlex 755 drive contains an EtherNet/IP adapter that is embedded on the main control board. The PowerFlex 755 drives supports Position Loop, Velocity Loop, Torque Loop, and Frequency Control axis configuration types.

The PowerFlex 755 drive has five option ports capable of accepting a combination of options for control, communication, I/O, feedback, safety, and auxiliary control power.

This embedded adapter lets you easily configure, control, and collect drive data over Ethernet networks. The drive can operate also in the integrated motion mode or the existing I/O mode.

When a PowerFlex 755 is used in Integrated Motion on EtherNet/IP mode, the Logix controller and Logix Designer are the exclusive owners of the drive (same as Kinetix). An HIM or other drive software tools, such as DriveExplorer and DriveTools SP, cannot be used to control the drive or change configuration settings. These tools can only be used for monitoring.

See these publications for more information:

- PowerFlex 750-Series AC Drives Programming Manual, publication 750-PM001
- PowerFlex 755 Drive Embedded EtherNet/IP Adapter User Manual, publication 750COM-UM001
- PowerFlex 755 Drive Embedded EtherNet/IP Adapter Installation Instructions, publication 750COM-IN001
- Integrated Motion on the EtherNet/IP network Reference Manual, publication MOTION-RM003, for information about what attributes are replicated in the drive

Add a PowerFlex 755 Drive

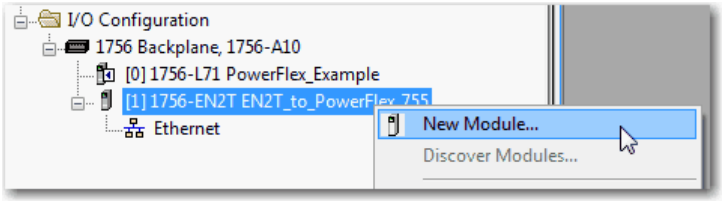
There are six PowerFlex 755 Ethernet drives that you can configure for Integrated Motion on the EtherNet/IP network.

TIP When you add drive modules for a sercos network, you see the power structures and catalog numbers. With Integrated Motion on the EtherNet/IP network, you assign the power structure later in the configuration process.

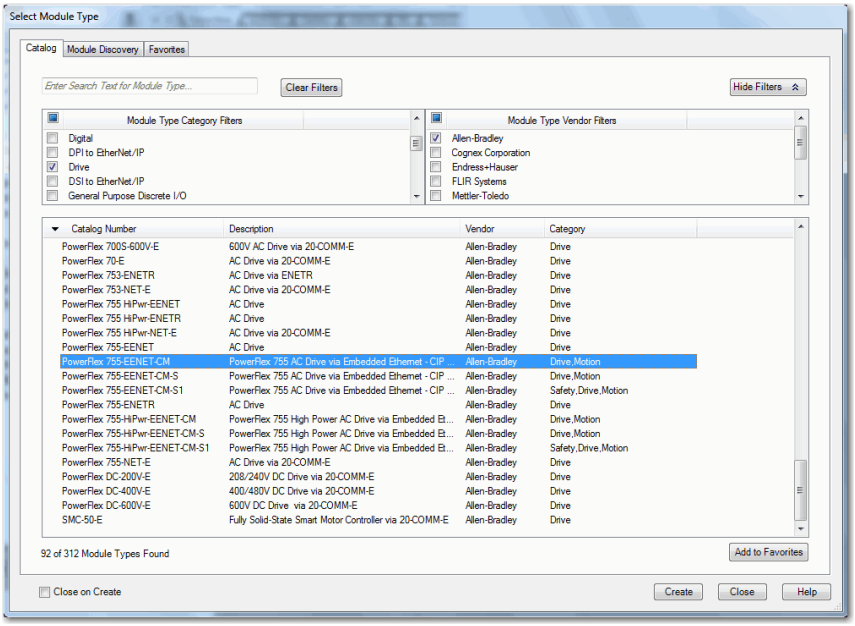
See Assign a Power Structure on page 52.

Follow these instructions to add the PowerFlex 755 drive your project.

1. Right-click the Ethernet network (node) and choose New Module.

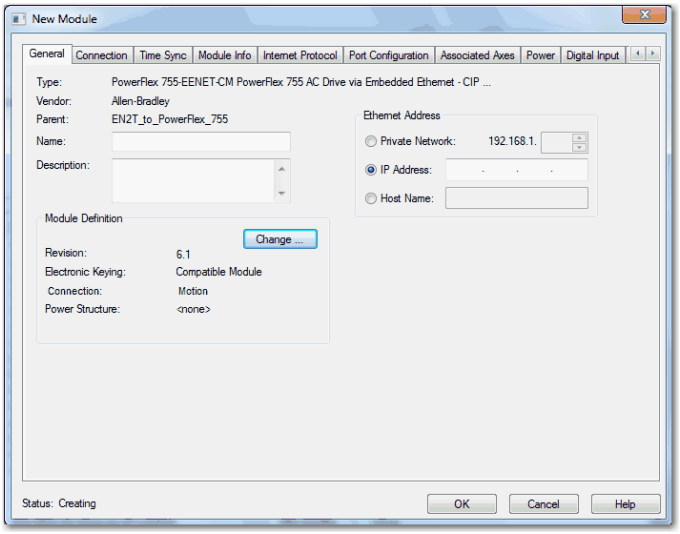


2. Clear the small 'select all' checkboxes, Module Type Category, and Vendor Filters.
3. In the Module Type Vendors Filters window, check Allen-Bradley.
4. In the Module Type Category Filters window, check and Drive.



5. Choose the drive and click create.

6. Type a Name for the module

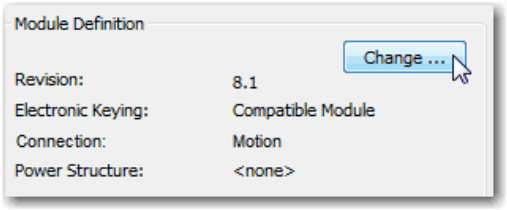


7. Type a description, if desired.
8. Assign an EtherNet/IP address.

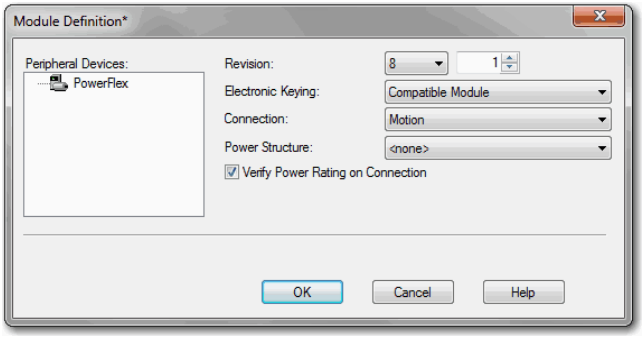
   See these manuals for information about configuring IP addresses:

   - PowerFlex 755 Embedded EtherNet/IP Adapter User Manual, publication 750COM-UM001
   - Ethernet User Manual, publication ENET-UM001

9. Under Module Definition, click Change.



   The Module Definition dialog box appears.



ATTENTION: The electronic keying feature automatically compares the expected module, as shown in the configuration tree, to the physical module before communication begins.

10. From the Electronic Keying pull-down menu, choose an option.

WARNING: When using motion modules, the electronic keying must be either `Exact Match' or `Compatible Keying'.

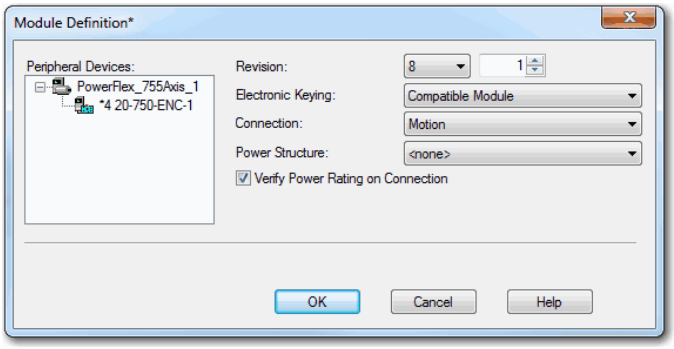
Never use `Disable Keying` with motion modules.

Select a Peripheral Feedback Device and Slot Assignment

Feedback devices on the PowerFlex 755 drives are called peripheral devices. You must assign the port/channel for each device you are using.

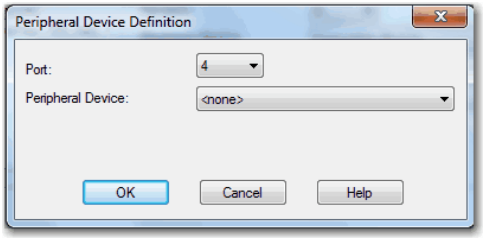
Follow these steps to select a feedback device.

1. Right-click on the device and choose New Peripheral Device.

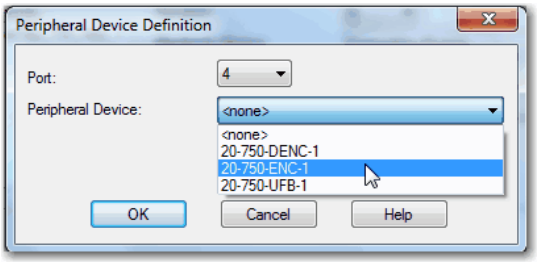


The peripheral device refers to the type of feedback device you are using with the PowerFlex 755 drive.

2. From the Port pull-down menu, choose the appropriate port/slot.

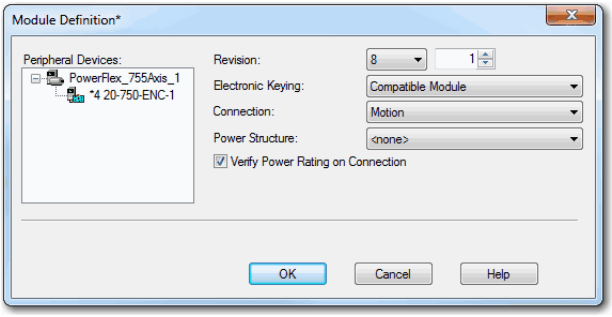


3. From the Peripheral Device pull-down menu, choose the appropriate catalog number.



4. Click OK.

The device is added. Notice that the feedback device appears.



Assign a Power Structure

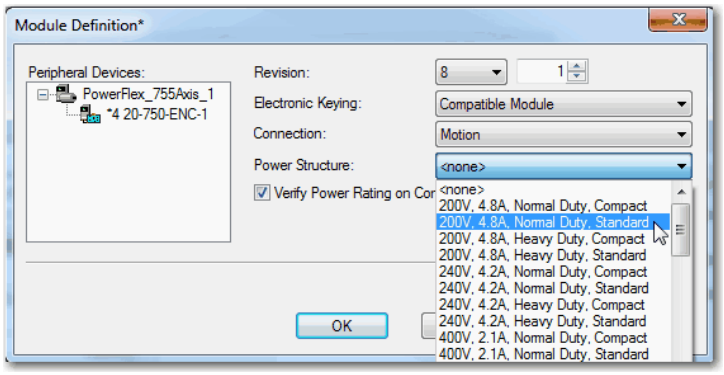
When you select a drive catalog number, you are specifying only a class of drives. You must assign the appropriate power structure you have installed.

You can locate the power structure reference numbers in these ways:

- On the actual product, usually on the right side of the drive
- In the device documentation
- On a purchase order

Follow these instructions to complete the drive configuration.

1. From the Power Structure pull-down menu, choose the appropriate power structure.



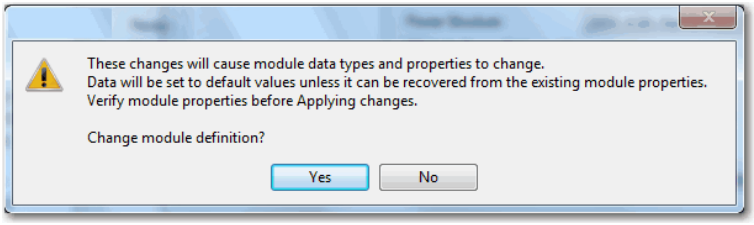
2. Click OK.

   If you go to the Associated Axis tab before you click OK and close the Module Properties dialog box, the option to create an axis is unavailable. Once you exit the dialog box, you can return to the Associated Axes tab and create an axis. You can create an axis also by right-clicking the Motion Group in the controller organizer.

See Create an Axis for a PowerFlex 755 Drive on page 54.

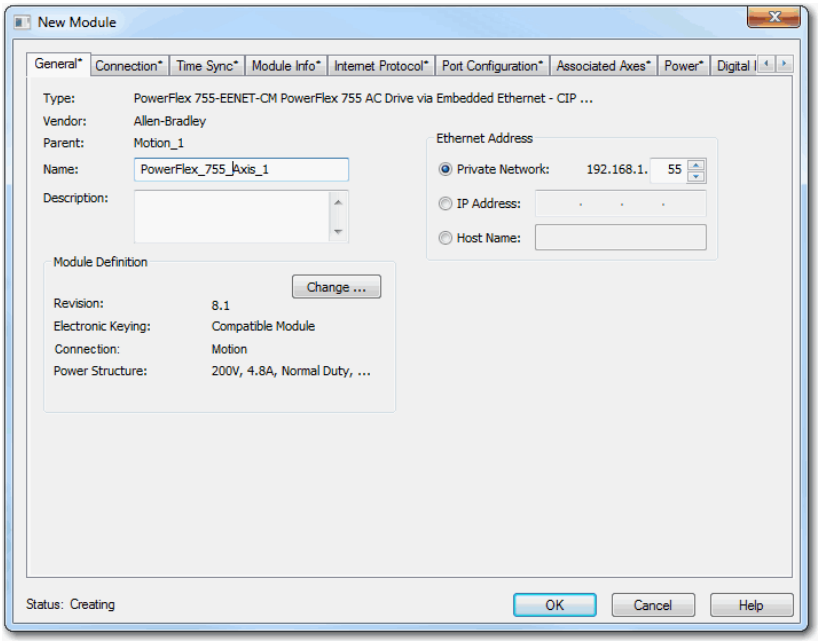
IMPORTANT When you change the major revision on the PowerFlex 755 drive, change the power structure, or change the peripheral feedback device, the axis is no longer associated with the modules.

When you change parameters, other related parameters change as well.


These changes will cause module data types and properties to change.
Data will be set to default values unless it can be recovered from the existing module properties.
Verify module properties before Applying changes.
Change module definition?
Yes
No

This message always appears after you have changed a configuration. This message is a reminder that when you change the power structure the identity of the drive changes. If your drive is associated to an axis and you change the power structure, the axis is disassociated.

Even though a feedback card has been selected, the drive is not configured. You must associate the axis first, and then you have the options to configure a feedback module.



3. On the General Tab, click OK to apply the changes.

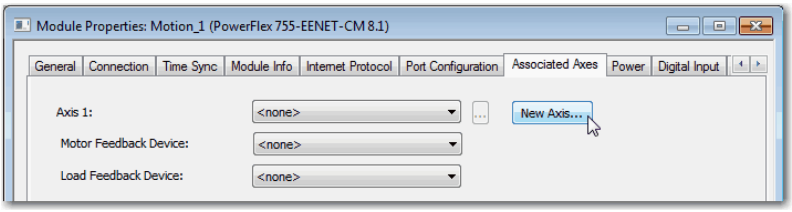
Create an Axis for a PowerFlex 755 Drive

Once you have added a drive, selected the power structure, and assigned a feedback device, you can create and configure an axis. You must apply the changes and exit the Associated Axis dialog box before the option to create an axis becomes available.

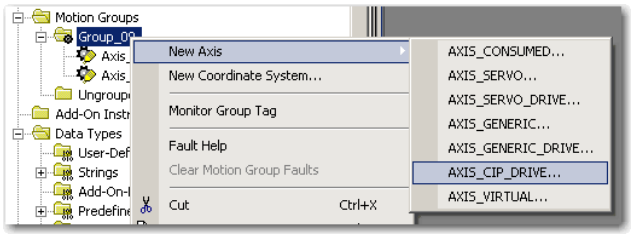
There are two approaches that you can take to create and configure an axis. You can create an axis first and then add the axis to your motion group, or you can create your motion group and then add an axis. The procedure that is outlined in this section takes the approach to create your axis first, configure the axis, and then add it to your motion group.

Follow these steps to create an axis.

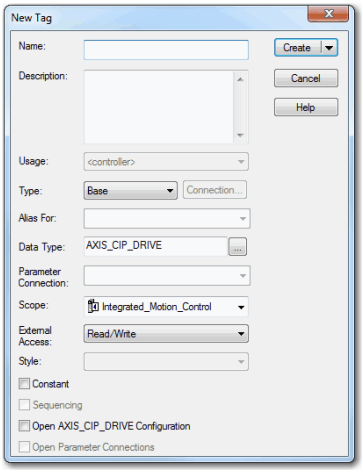
1. Double-click the drive in the Controller Organizer.
2. Click the Associated Axes tab.
3. Click New Axis.



TIP You can also create an axis directly off the Motion Group in the controller organizer.



The New Tag dialog box appears.



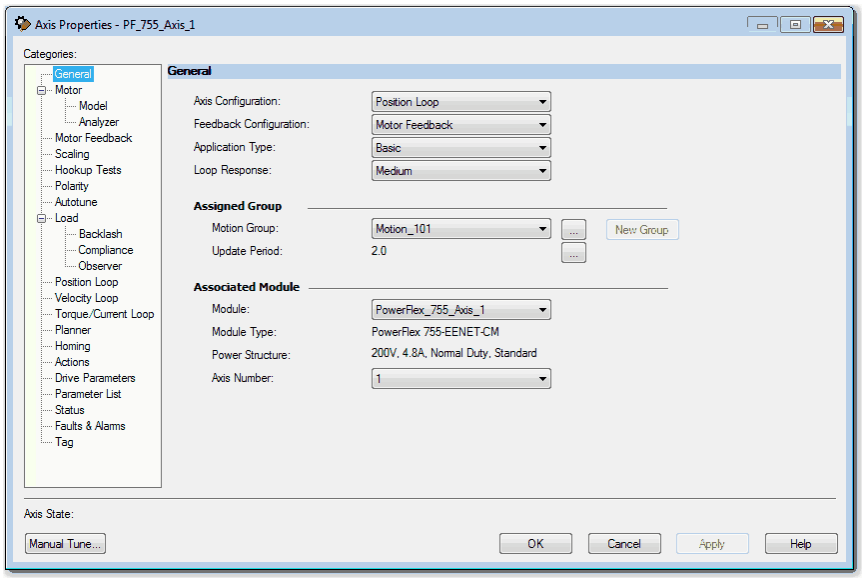
4. Type the name.

5. Type a Description, if desired.

   The fields in the next steps are automatically entered for the AXIS_CIP_DRIVE data type.

6. Change the Tag Type, Data Type, Scope, and External Access, if needed.
7. Click Create.

   For more information about External Data Access Control and Constants, see the Logix5000 Controllers I/O and Tag Data Programming Guide, publication 1756-PM004.



The axis parameters that you configure on the General dialog box result in the presentation of attributes and parameters that are available for the combination of your selections.

IMPORTANT

The AXIS_CIP_DRIVE axis properties dialog boxes appear or disappear depending on the Axis Configuration, except for Tag, Status, Faults, Dynamics, and Homing, they are always present.

Optional attributes that are related to each integrated motion axis you create come and go based on what combination of axis characteristics you define.

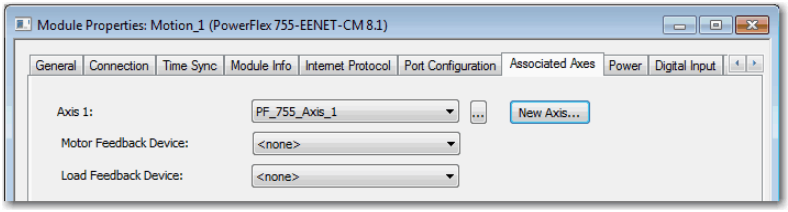
Axis Attributes control modes are either Required, Optional, or Conditional. Elements of the General dialog box depend on the control mode you select. The Axis Attribute determines the usage definition internally.

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003, for complete information on the Axis Attributes and Control Modes.

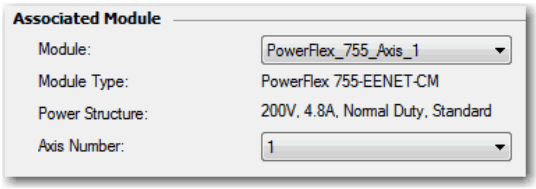
Map the PowerFlex 755 Drive Port Assignment to the Axis

Follow these instructions to map the drive port to the axis.

1. Go the Module Properties of the drive.
2. Click the Associated Axis tab.



   Axis 1 on the Associated Axes tab in Module Properties corresponds to the Axis 1 listed on the General tab on the Axis Properties, see step 2 on page 54.



   For more detailed examples, see Axis Configuration Examples for the PowerFlex 755 Drive on page 121.

3. Click OK.

Establish Feedback Port Assignments for the PowerFlex 755 Drive

There are two ways to establish the drive/axis associations.

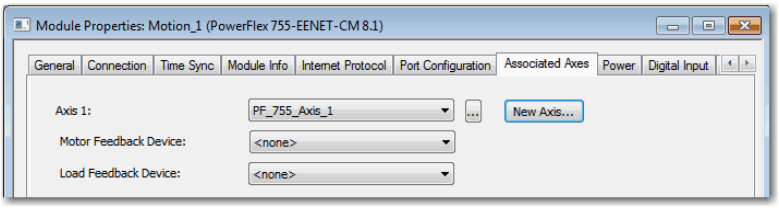
- The first way is to assign the drive to the axis on the Associated Axis tab in the Module Properties dialog box.
- The second way is to assign the axis to the drive on the General Category dialog box.

Unlike a Kinetix 6500 drive where the motor feedback association is automatic, you must manually establish the motor feedback (Port/Channel) assignment for the PowerFlex 755 drive.

Follow these instructions to associate an axis to the drive by using the Module Properties dialog box for the drive.

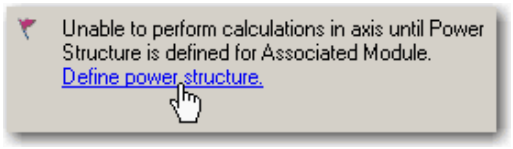
1. Right-click the PowerFlex 755 and choose Properties.

2. Click the Associated Axes tab.



3. From the Axis 1 pull-down menu, choose the axis to associate the drive to.

   When you select the axis, the power structure of the drive is verified. If you have not assigned a power structure, this message appears on the General dialog box.


Unable to perform calculations in axis until Power Structure is defined for Associated Module.
Define power structure.

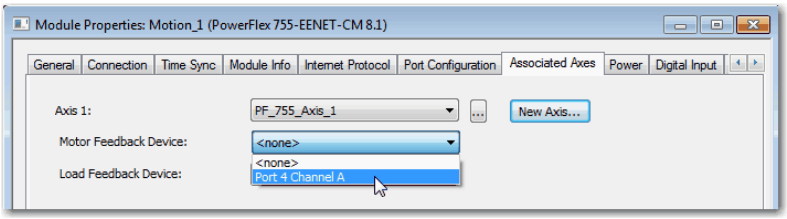
Click the hyperlink to go to the Module Properties dialog boxes for the drive so you can assign a Power Structure.

   This message means that without fully defining the drive with a power structure the factory defaults cannot be computed.

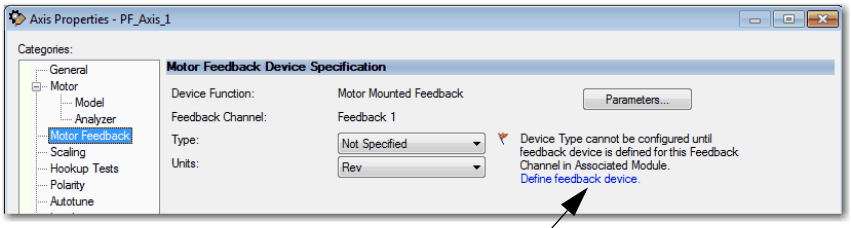
   See Assign a Power Structure on page 52.

4. From the Motor/Master Feedback Device pull-down menu, choose the port and channel combination that is applicable to your hardware configuration.

   In this case, Port 4 Channel A is associated with the Motor Feedback device.



   Similarly, if you have not assigned the feedback device on the drive's Module Properties dialog box, you will get this message on the Motor Feedback dialog box telling you to define the feedback device.



Click the link to define the feedback device.

   See Configure the Associated Axis and Control Mode on page 59.

The ports and channels that you can select are related to what hardware you have installed. The choices depend on the installation and automatically appear.

- If you are configuring a Position Loop, you can choose between Motor Feedback, Dual Feedback, and Dual Integrated Feedback.
- If you are configuring a Torque or Velocity Loop, you will have only the option for Motor Feedback.
- If you are configuring for Frequency Control, no feedback is available.

For an Axis Configuration of Position Loop and a Feedback Configuration of Motor Feedback, using a UFB peripheral device, see Example 1: Position Loop with Motor Feedback Using a UFB Feedback Device on page 122.

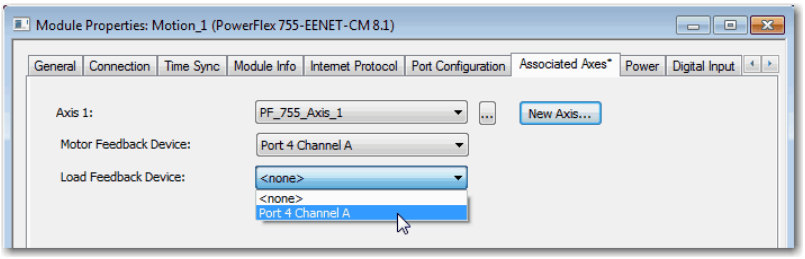
Axis 1 on the Associated Axes tab in Module Properties corresponds to Axis 1 listed on the General tab in the Axis Properties, see step 2 on page 54.

The axis tag field appears as Axis 1, for example, Axis_I_Position_Motor. The Motor/Master Feedback Device (Motor Feedback Port) is populated based on the Feedback Configuration type.

For more information about control modes and control methods, see the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003.

5. If you chose Dual Feedback as the Feedback Configuration type for the axis on the General tab, choose the Load Feedback device.

   For an Axis Configuration of Position Loop and a Feedback Configuration of Dual (or Load) Feedback, see Example 2: Position Loop with Dual Motor Feedback Via a UFB Feedback Device on 125.

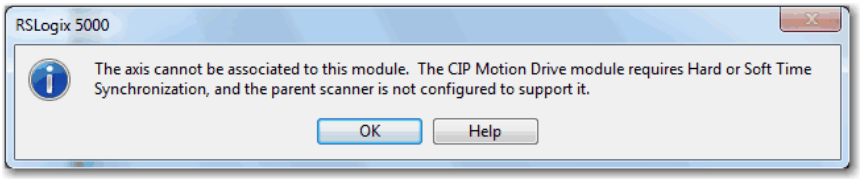
   

   See Feedback Configuration Options for the PowerFlex 755 Drive on page 73.

   For more examples, see Axis Configuration Examples for the PowerFlex 755 Drive on page 121.

6. Click OK to apply the changes and close the dialog box.

If you have not enabled Time Synchronization, this message appears.


RSLogix 5000
The axis cannot be associated to this module. The CIP Motion Drive module requires Hard or Soft Time Synchronization, and the parent scanner is not configured to support it.
OK
Help

You must go to the 1756-EN*x*T communication module properties and enable time synchronization.

See Add a 1756-ENxTx Communication Module on page 95.

Configure the Associated Axis and Control Mode

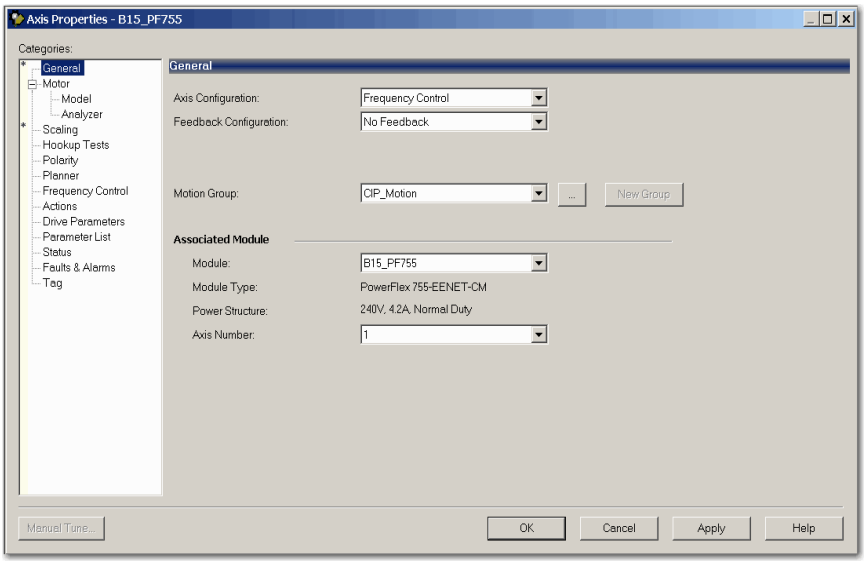
Now that the axis is associated to the drive, meaningful values are available for other axis configuration properties. The combination of the attributes that are selected when configuring an axis and feedback determines the control mode.

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003, for complete information on axis attributes and control modes.

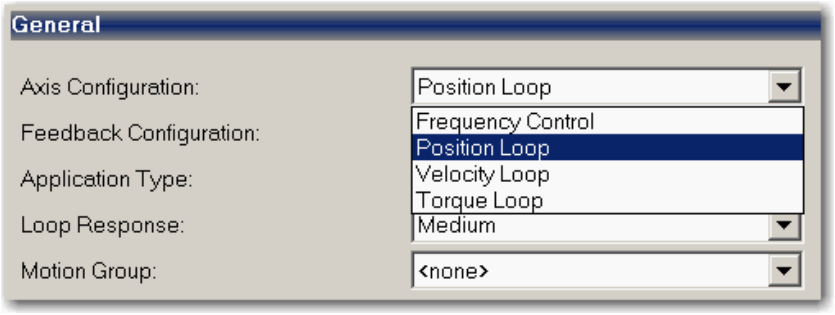
Follow these steps to configure an axis.

1. In the Controller Organizer, double-click the axis that you want to configure.

   The Axis Properties General dialog box appears.

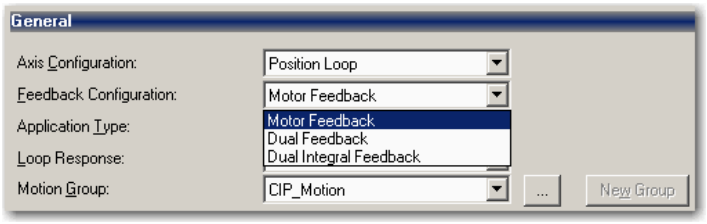


2. Choose an Axis Configuration.



TIP The associated drive determines what axis and feedback configuration choices are presented.

3. Choose a Feedback Configuration type.

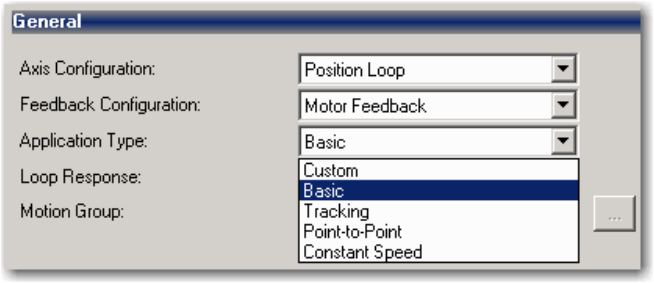


This table compares the feedback type and loop type.

Feedback Type	Loop Type	PowerFlex 755	PowerFlex 527
Motor Feedback	P, V, T	Yes	No
Motor Feedback	P, V, F	No	Yes
Load Feedback	P, V, T	No	No
Dual Feedback	P	Yes	No
Dual Integrator	P	Yes	No
Master Feedback	N	No	No
No Feedback	V, F	Yes	No

For more information, see Feedback Configuration Options for the PowerFlex 755 Drive on page 73.

4. Choose an Application Type, if applicable.



TIP Application Type defines the servo loop configuration automatically. These combinations determine how the calculations are made, which can reduce the need to perform an Autotune or a Manual Tune.

The Application Type determines the type of motion control application. This attribute is used to set the Gain Tuning Configuration Bits.

This table provides the gains established base on the application type.

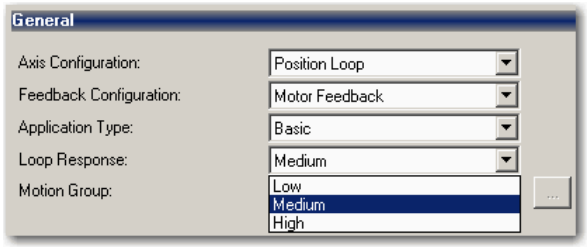
Table 11 - Customize Gains to Tune

Application Type	Kpi	Kvi	ihold	Kvff	Kaff	torqLPF
Custom(1)	-	-	-	-	-	
Basic (V20 and later)	No	No	No	Yes	No	Yes
Basic (V19 and earlier)	No	No	No	No	No	-
Tracking	No	Yes	No	Yes	Yes	Yes
Point-to-Point	Yes	No	Yes	No	No	Yes
Constant Speed	No	Yes	No	Yes	No	Yes

(1) If you set the type to Custom, you can control the individual gain calculations by changing the bit settings in the Gain Tuning Configuration Bits Attribute.

TIP For information about other attribute calculations, see the specific attribute description in the Integrated Motion on the EtherNet/IP Reference Manual, publication MOTION-RM003.

5. Choose a Loop Response, if applicable.



6. Click Apply.

Create a Motion Group

All axes must be added to the Motion Group in your project. If you don't group the axes, they remain ungrouped and unavailable for use.

You must create a Motion Group for an axis to be configured properly.

Table 12 - Position Loop Configured Axes

Controller	Communication Modules	Supported Axes(1)		
		Position Loop	Other Loop Types	CIP_Drives(2)
1756-L6*x*(3) and L7*x*	1756-EN2T and 1756-EN2TF	8	Up to 100	
1756-L6*x*(3) and L7*x*	1756-EN3TR	100	Up to 100	
	1756-EN2TR	8	Up to 100	
1769-L18ERM	Embedded Ethernet	2	Up to 100	8 max in I/O tree
1769-L27ERM	Embedded Ethernet	4	Up to 100	16 max in I/O tree
1769-L30ERM	Embedded Ethernet	4	Up to 100	16 max in I/O tree
1769-L33ERM	Embedded Ethernet	8	Up to 100	32 max in I/O tree
1769-L36ERM	Embedded Ethernet	16	Up to 100	64 max in I/O tree

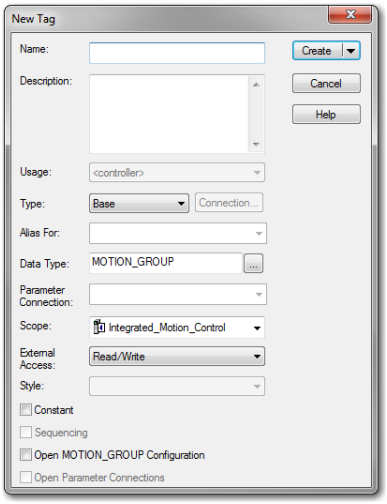
(1) Multiple controllers can control drives on a common 1756-EN*x*T*x* module, so based on the TCP connection limit, up to 128 can be supported.

(2) If more than the maximum I/O modules are configured in the I/O tree under Embedded Ethernet, then you will get a Project Verify Error: Error: Maximum number of nodes on the local Ethernet port has been exceeded.

(3) The 1756-L6*x* controllers are not supported in the Logix Designer application, Version 21.00.00.

You can have eight Position Loop axes per 1756-EN2T module. Each drive requires one TCP and one CIP connection. If you have other devices that consume TCP connections on the module, it reduces the number of drives you can support. Only the drives/axes configured for Position Loop are limited. Frequency Control, Velocity Loop, and Torque Loop configured drives/axes are not limited.

1. Click New Group.



2. Type a name.

3. Type a description, if desired.

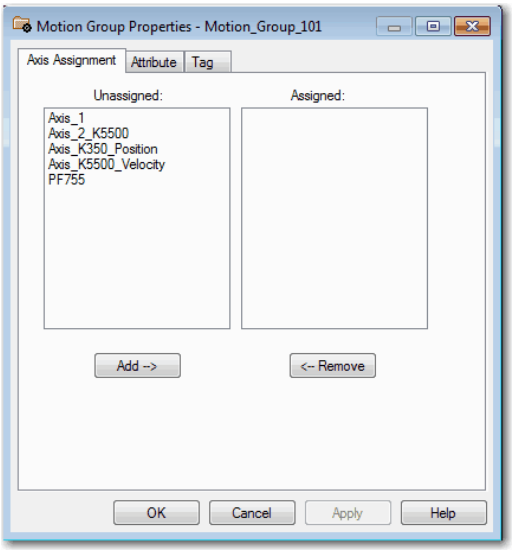
   The fields in the next steps are automatically entered for the Motion_Group data type.

4. Change the Tag Type, Data Type, Scope, and External Access, if needed.

   For more information about External Data Access Control and Constants, see the Logix5000 Controllers I/O and Tag Data Programming Guide, publication 1756-PM004.

5. Check Open MOTION_GROUP configuration and click Create.

   The Motion Group Wizard appears with unassigned axes.

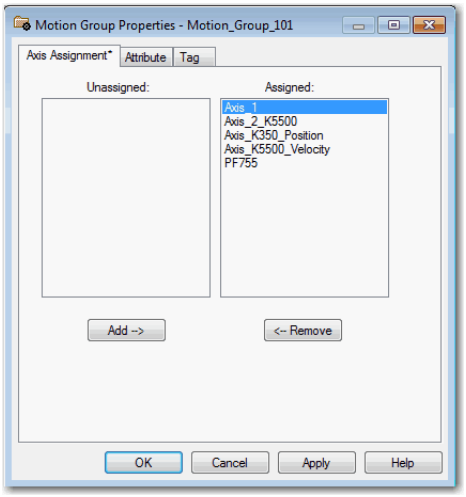


Associate the Axis to the Motion Group

There are three ways to assign axes to a Motion Group:

- Create a motion group. The Motion Group wizard appears and takes you through the necessary screens.
- Open the Motion Group properties and make changes.
- Drag the axis into the Motion Group in the Controller Organizer.

1. Select an axis and click Add.
2. Verify that the axis has been assigned to the group.



3. Click OK.

   The axis appears under the Motion Groups.

Set the Base Update Period

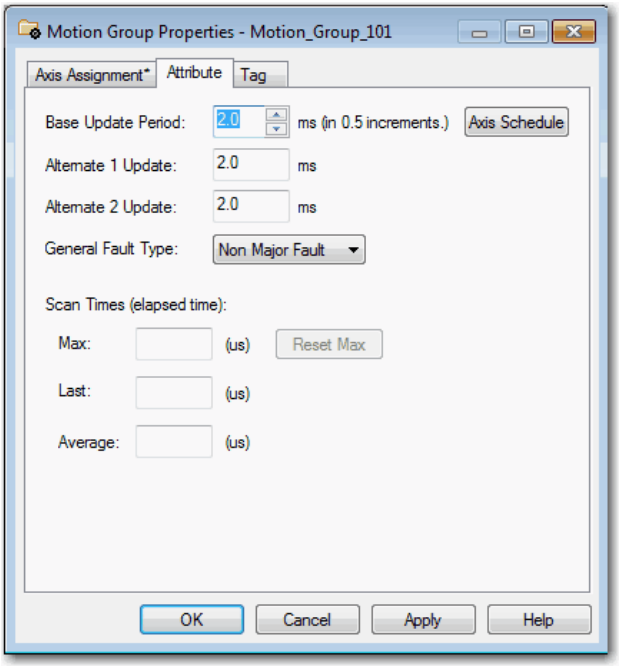
The Base Update Period is basically the RPI rate for Ethernet communication between the controller and the motion module, a Unicast connection. It also sets the motor feedback that is returned from the drive in the drive-to-controller connection.

There are two alternate update periods that you can configure when using Axis Scheduling. See Configure Axis Scheduling on page 77 for details.

The Base Update Period is how often the motion planner runs. When the motion planner runs, it interrupts most other tasks regardless of their priority. The motion planner is the part of the controller that takes care of position and velocity information for the axes.

Follow these steps to set the Base Update Period.

1. Click the Attribute tab in the Motion Group Properties dialog box.

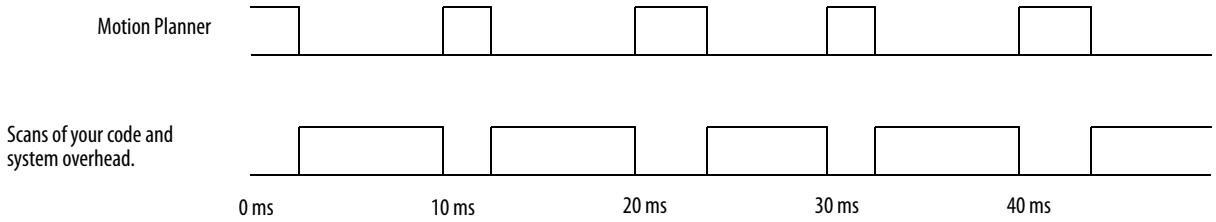


2. Set the Base Update Period to 3.0...32.0 ms.

   For the PowerFlex 755 drive, the minimum Base Update Rate 3 ms.

TIP	Check to see if the Last Scan time values on the Attribute tab are less. Typically, the value is less than 50% of the Base Update Period.

Figure 3 - Base Update Period Example



In this example, the Base Update Period = 10 ms. Every 10 ms the controller stops scanning your code and whatever else it is doing and runs the motion planner.

The Base Update Period is a trade-off between updating positions of your axes and scanning your code. For a 1756-L6*x* or 1756-L6*x*S controller, you can have 4 axes/ms and 8 axes/ms for the 1756-L7*x* controller.

For detailed information on the Axis Scheduling function, Axis Assignment tab, and Alternate Update Period Scheduling, see Configure Axis Scheduling on page 77.

Integrated Architecture Builder

To help you determine motion system performance, use the motion performance calculator in the Integrated Architecture Builder (IAB).

The IAB is a graphical software tool for configuring Logix-based automation systems. It helps you select hardware and generate bills of material for applications that include controllers, I/O, networks, PowerFlex drives, On-Machine cabling and wiring, motion control, and other devices.

You can find the software at
http://www.rockwellautomation.com/en/e-tools/configuration.html

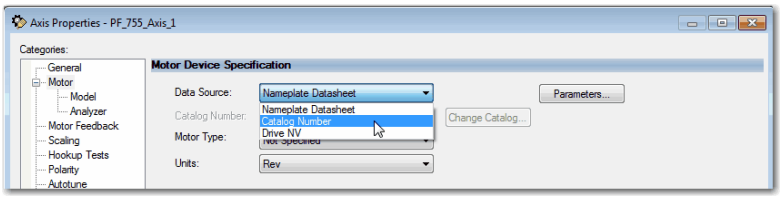
Select the Motor Data Source

The Motor Data Source is where you tell the axis where the motor configuration values are originating. You can select a motor from the database, nameplate, or nonvolatile memory.

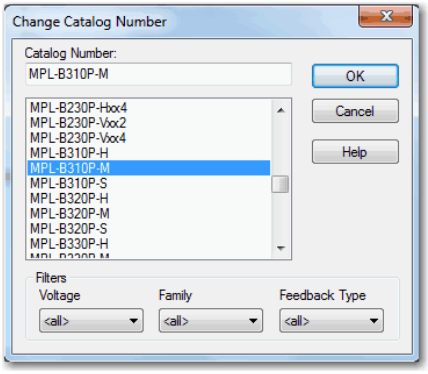
Choose Catalog Number as the Motor Data Source

Follow these steps to identify the specification information that is originating from the Motion Database.

1. If the Axis Properties dialog box is not open, double-click the axis.
2. Click the Motor tab of the Axis Properties dialog box.
3. From the Data Source pull-down menu, choose Catalog Number.

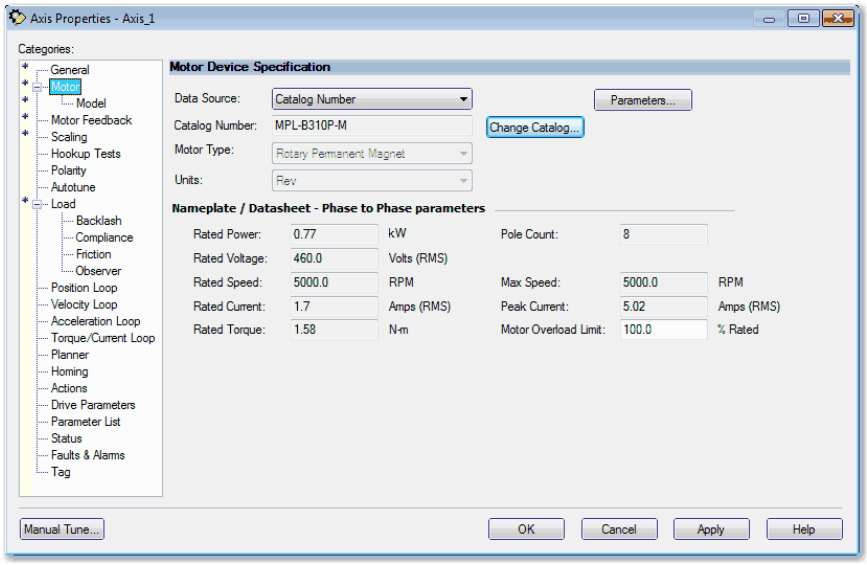


4. Click Catalog Number.
5. Click Change Catalog.
6. Select a motor and click OK.



The Motor dialog box is populated with all information related to the motor you selected from the Motion Database.

Motor Dialog Box



7. Click Apply.

Motor Model Dialog Box

The Motor Model dialog box displays the Motor Model Phase to Phase parameters. The parameters that are available depends on the Motor Data Source. Nameplate Datasheet is the only Motor Data Source that lets you input the values. The Motor Analyzer is helpful when configuring the Motor Model dialog box parameters.

See Motor Model Dialog Box on page 71.

Motor Analyzer Dialog Box

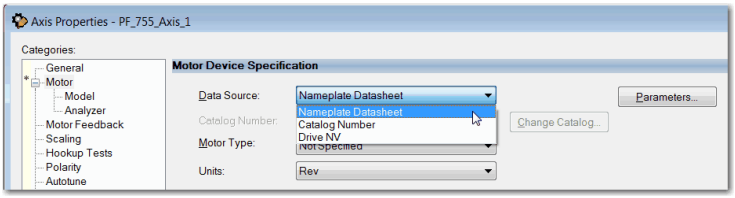
The Motor Analyzer provides the Dynamic Motor Test for an AC drive, such as the PowerFlex 755 drive.

See Motor Analyzer Dialog Box on page 71.

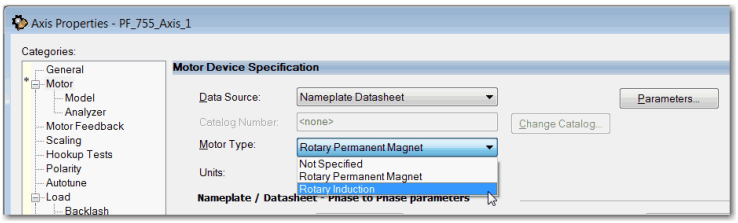
Choose Nameplate as the Motor Data Source

The Nameplate option requires you to enter the motor specification information. You can find the information on the hardware nameplate or product data sheets.

1. From the Motor dialog box of Axis Properties, choose Nameplate Datasheet.



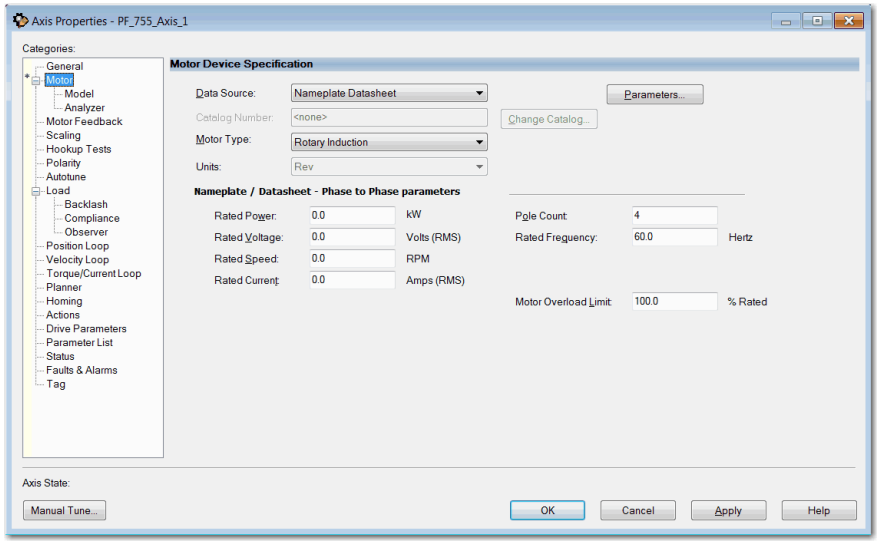
2. Choose a motor type.



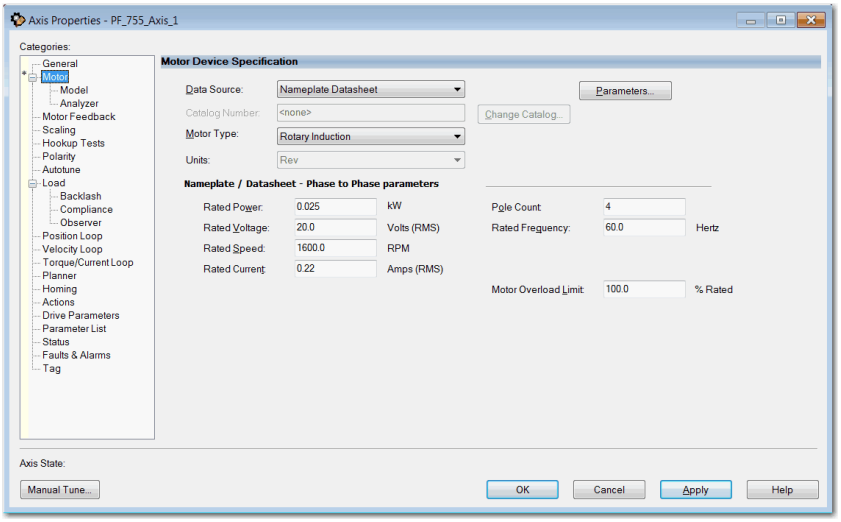
This table describes the motor types that are available.

Motor Type	PowerFlex 755	PowerFlex 527
Rotary Permanent Magnet	Yes	No
Linear Permanent Magnet	No	No
Rotary Induction	Yes	Yes

Notice that the motor information fields display zeros.



3. Enter the parameters information from the motor Nameplate Datasheet.
4. Click Apply.

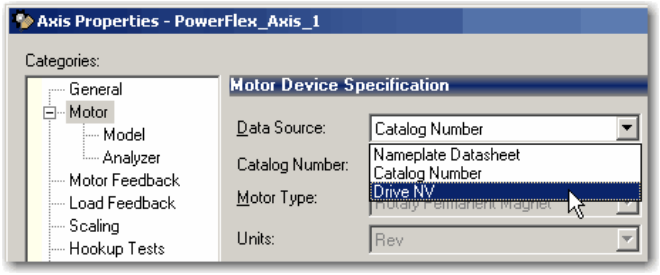


Choose Drive NV as the Data Source

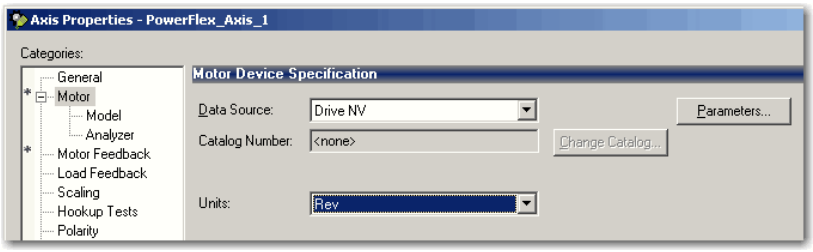
When you choose Drive NV, the motor attributes are derived from the nonvolatile memory of a drive. Only a minimal set of motor and motor feedback (Feedback 1) attributes are required to configure the drive.

Follow these instructions to choose a data source.

1. From the Data Source pull-down menu, choose Drive NV.

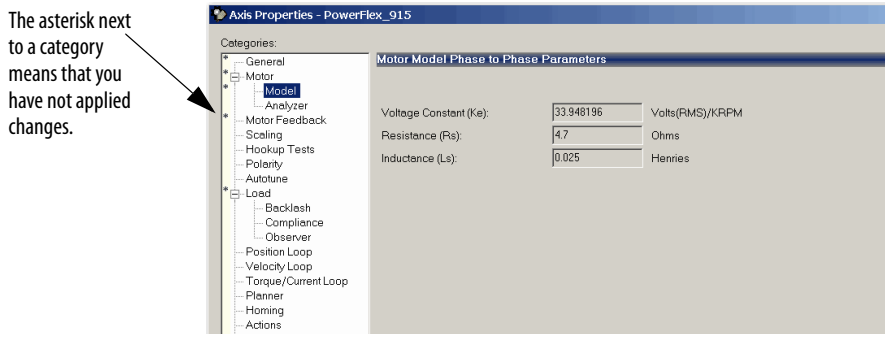


2. From the Units pull-down menu, choose Revolutions or Meters.



Motor Model Dialog Box

The Motor Model dialog box displays additional information based on the motor, axis, and feedback configuration types you choose.



- If the motor data source is Catalog Number, the fields are populated automatically from the database and the fields are read-only.
- If the motor data source is Nameplate Datasheet, you can to enter the information.

TIP You can leave the default values, go online, and run a Motor Test to get the proper values from the drive.

See Hookup Tests Dialog Box on page 150.

- If the motor data source is Drive NV, the data comes from the nonvolatile memory of the drive.
- If you select Catalog Number, Motor NV, or Drive NV, the values display as read-only.

Motor Analyzer Dialog Box

The Motor Analyzer provides the following three tests:

- Dynamic Motor
- Static Motor
- Calculate Model

The tests analyze motor parameters for rotary and linear induction motors and permanent magnet motors. The parameters that appear on the tests are dependent on the motor type you choose.

TIP If the motor you are using is a Permanent Magnet, the Dynamic Motor is the only test that appears.

Motor Analyzer Dialog Box

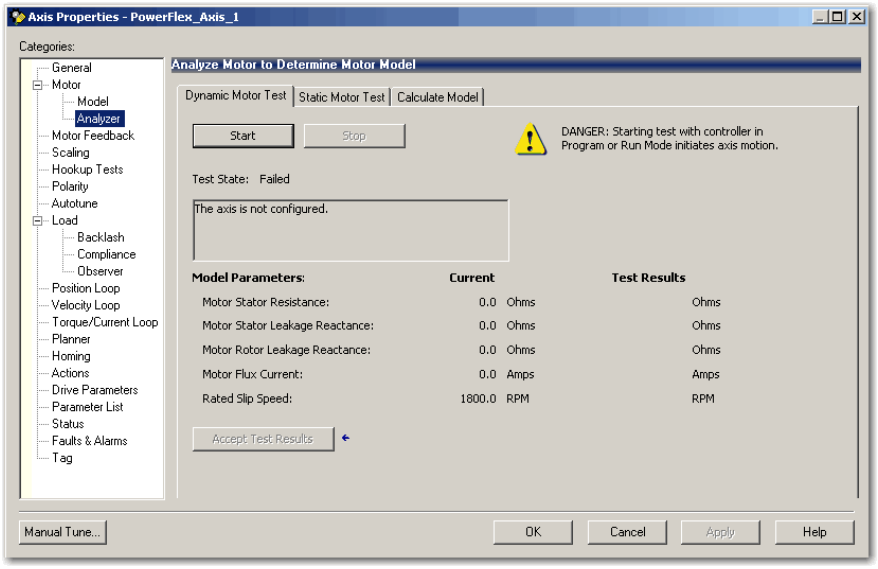


Table 13 - Motor Analyzer Parameters

Parameter	Description
Motor Resistance	Specifies the phase-to-phase, resistance of a permanent magnet motor.
Motor Inductance	Specifies the phase-to-phase, inductance of a permanent magnet motor.
Motor Rotary Voltage Constant	Specifies the voltage, or back-EMF, constant of a rotary permanent magnet motor in phase-to-phase RMS Volts per KRPM.
Motor Stator Resistance	Specifies the Y circuit, phase-neutral, winding resistance of the stator as shown as R1 in the IEEE motor model.
Motor Stator Leakage Reactance	Specifies the Y circuit, phase-neutral, leakage reactance of the stator winding, at rated frequency, as shown as X1 in the IEEE motor model.
Motor Torque Constant	Specifies the torque constant of a rotary permanent magnet motor in Newton-meters per RMS amp.
Motor Rotor Leakage Reactance	Specifies the Y circuit, phase-neutral, equivalent stator-referenced leakage inductance of the rotor winding, at rated frequency, as shown as X2 in the IEEE motor model.
Motor Flux Current	Id Current Reference that is required to generate full motor flux. This value is closely approximated by the No Load Motor Rated Current commonly found in Induction Motor data sheets. The Kinetix 350 does not support this parameter.
Rated Slip	Rated Slip is the amount of slip at motor rated current (full load) and motor rated frequency.

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003, for complete information on Axis Attributes.Motor Feedback

The PowerFlex 755 drive requires a peripheral feedback device. As with all parameters, the types of feedback available are dependent on what you select on the General dialog box for Feedback Configuration.

Axis Configuration Type	Parameters
Frequency Control	No Feedback
Position Loop	• Motor Feedback, one mounted device • Dual Feedback, two mounted devices • Dual Integral Feedback, two mounted devices
Velocity Loop	• No Feedback • Motor Feedback, mounted device
Torque Loop	• Motor Feedback, mounted device

Feedback Configuration Options for the PowerFlex 755 Drive

The following feedback module combinations are supported.

Option	Supported Module	Catalog Number	Valid Ports
Two Feedback Options	Single Incremental Encoder	20-750-ENC-1	4…8
	Dual Incremental Encoder	20-750-DENC-1	4…8
	Universal Feedback Card	20-750-UFB-1	4…6
Two Feedback Options and One Safe Torque Off Option	Single Incremental Encoder	20-750-ENC-1	4 and 5
	Dual Incremental Encoder	20-750-DENC-1	4 and 5
	Universal Feedback	20-750-UFB-1	4 and 5
	Safe Torque Off	20-750-S	6
Two Feedback Options and One Safe Speed Monitor Option(1)	Single Incremental Encoder	20-750-ENC-1	4 and 5
	Dual Incremental Encoder	20-750-DENC-1	4 and 5
	Universal Feedback	20-750-UFB-1	4 and 5
	Safe Speed Monitor	20-750-S1	6

(1) The Safe Speed Monitor option module must be used with the 20-750-DENC-1 Dual Incremental Encoder module or the 20-750-UFB-1 Universal Feedback module.

For more information, see the PowerFlex 750-Series AC Drive Installation Instructions, publication 750-IN001.

There are seven available peripherals:

- HIM
- I/O
- Communications, Ethernet Standard
- Aux Power
- Safety
- Encoder Interface
- Universal Feedback

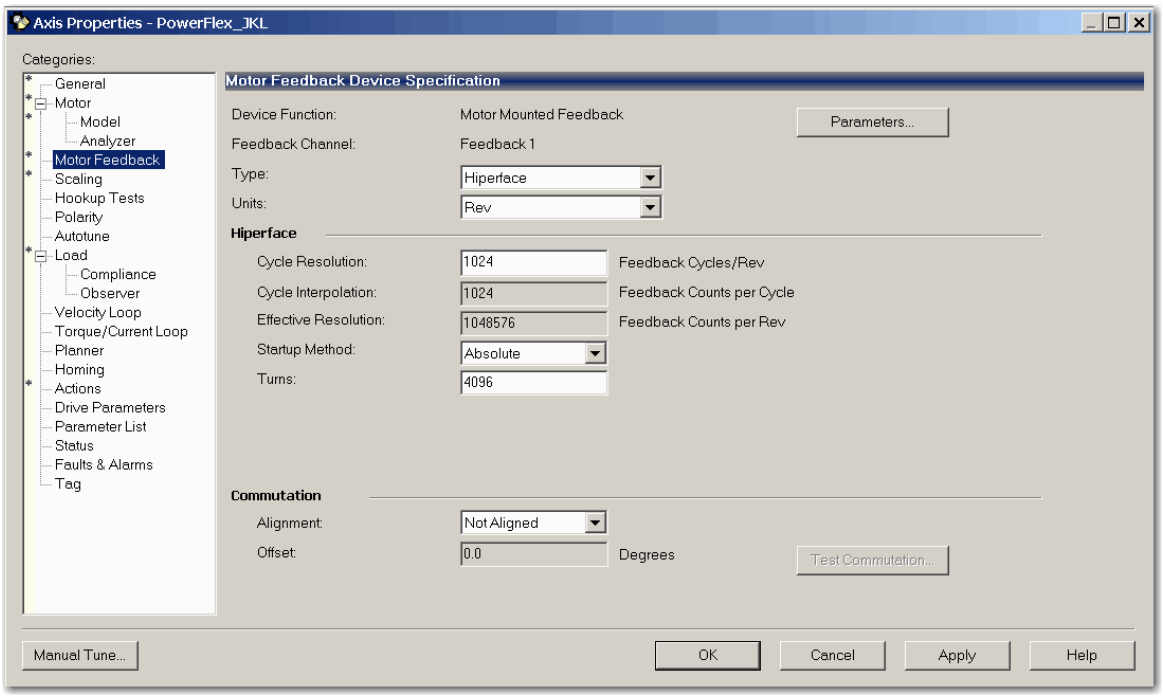
This table lists valid peripheral devices and ports for various PowerFlex drives.

Table 14 - Peripheral Devices That Drives Support

Drive	Ports	Peripheral Devices
PowerFlex 755EENET-CM	4, 5, 6, 7, 8	• HIM, Safety, Encoder Interface, Universal Feedback. • HIM is only supported in CIP - Control Mode. • Integrated Motion on the EtherNet/IP Network does not support I/O, Aux Power, 20-COMM-x.
PowerFlex 755EENET-CM-S	4 and 5 6 is reserved for Safety	
PowerFlex 755-EENET-CM-S1	4 and 5 6 is reserved for Safety	

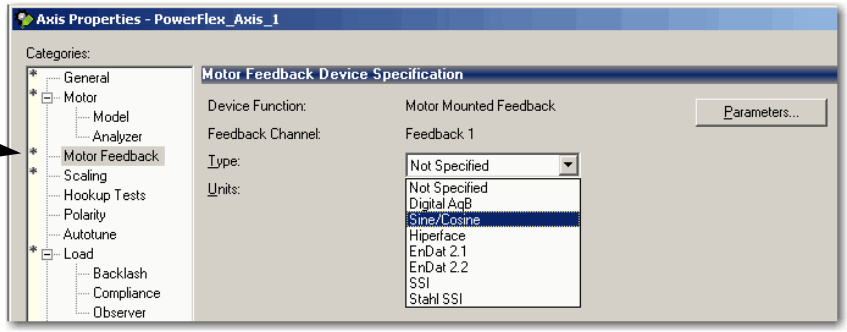
For more listings of peripheral devices that PowerFlex drives support, see the PowerFlex 755 Drive Embedded Ethernet Adapter User Manual, publication 750COM-UM001, and the PowerFlex 755 Drive Embedded EtherNet/IP Adapter Installation Instructions, publication 750-IN001.

The Motor Feedback dialog box contains the information for the feedback device. This category dialog box is not available for Frequency axis configuration and is dependent on the axis configuration type and the motor selection.

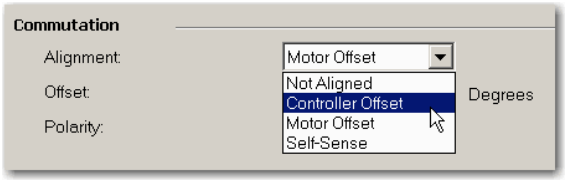


Select a Feedback Type and Units. The type of feedback available depends on the axis and feedback configurations.

The asterisk next to a category means that you have not applied changes.



1. From the Type pull-down menu, choose the appropriate type of motor feedback.
2. Click Apply and OK to exit the Motor Feedback dialog box.
3. Set the commutation alignment type and the percentage of offset.



TIP All commutation attributes apply only to permanent magnet motors.

If you are using a motor that is not in the database, the default is Not Aligned. If the motor is in the database, the alignment is set to Controller Offset.

Type	Description
Not Aligned	Not Aligned indicates that the motor is not aligned, and that the Commutation Offset value is not valid. If the Commutation Offset is not valid, the drive cannot use the value to determine the commutation angle. Any attempt to enable the drive with an invalid commutation angle results in a Start Inhibit condition.
Controller Offset	It applies the Commutation Offset value from the controller to determine the electrical angle of the motor.
Motor Offset	The drive derives the commutation that is offset directly from the motor.
Self-Sense	The drive automatically measures the commutation that is offset when it transitions to the Starting state for the first time after a power cycle. This generally applies to a PM motor equipped with a simple incremental feedback device.

4. Go online with the controller and click Test Commutation.

   When the test is complete, you see the status of the polarity.

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003, for complete descriptions of the axis attributes.

Configure Axis Scheduling

This chapter describes how to configure the Axis Scheduling feature that is located in the Motion Group properties dialog box.

Topic	Page
Example Axis Scheduling Application	78
Axis Scheduling Configuration	79
Motion Utilization	87

Axis Scheduling provides a way for you to configure drives to run at different update rates. Axis Scheduling can improve the performance of your controllers. You can use Axis Scheduling with integrated motion drives and virtual axes. By using Axis Scheduling you can optimize your controller, network, and drive performance. For smaller controller applications (CompactLogix), you can expect to see a significant improvement in system performance.

Many applications have motion drives with different performance requirements. At the simplest level, motion drives can be assigned into a ‘fast’ and ‘slow’ update rate groupings.

- The ‘fast’ group typically includes high speed coordinated process positioning drives with aggressive PCAM or interpolation profiles and auxiliary functions like registration position/velocity phase correction.
- The ‘slow’ group typically includes noncoordinated motion drives used for automatic machine reconfiguration, noncoordinated point-to-point motion process drives, or coordinated drives with less aggressive PCAM or gearing functions.

Axis Scheduling is compatible with these products:

- ControlLogix L7x and later controllers
- GuardLogix L7x and later controllers
- CompactLogix 5370 and later controllers
- All Integrated Motion EtherNet/IP drives, for example, Kinetix, PowerFlex and other third-party drives

Example Axis Scheduling Application

Axis Scheduling can improve ControlLogix and CompactLogix EtherNet/IP Integrated Architecture Motion system performance by reducing average Logix controller and EtherNet/IP network utilization. Axis Scheduling supports three separate controller/network motion drive update rates per controller, one rate for high performance drives, and two additional rates for lower performance drives.

For example, suppose you have a robot removing product from a conveyor belt that has three precision axes on the robot and four general purpose axes on the conveyor belt. You would like to configure the controller to run all seven axes at 2 ms to best control the precision axes, but this will take your controller's network utilization too high. In the past, one option would have been to run all seven axes 8 ms, but this is not fast or precise enough for the robot axes. So you might have had to add a second controller and Ethernet module to get the performance you needed. Axis Scheduling lets you configure the axes at different rates based on the needs of the application, balancing the motion performance and network utilization of your controller.

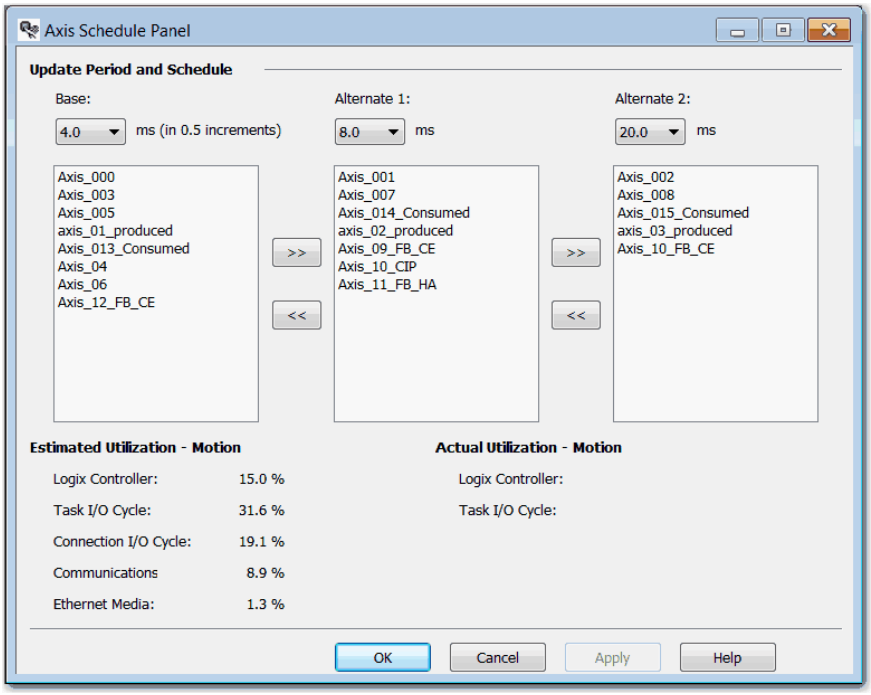
With Axis Scheduling, you can configure the axes on the robot to run at a high base update rate (2 ms) and then configure the conveyor to run at a slower update rate (8 ms).

Being able to configure three update periods, the four conveyor axes can run as a single channel, thus appearing to the controller as a single drive. The axes are updated round-robin style; every 2 ms, three of the robot axes are updated as well as one of the conveyor axes.

During the next update, three robot axes are updated and then the next conveyor axis is updated; eventually all conveyor axes are updated and the process starts again. The controller updates four axes every update period. The controller can handle the load of four axes easier than a load of seven axes. This improves the performance of the controller.

Axis Scheduling Configuration

In Logix Designer, you use the Axis Schedule Panel to configure the update periods. The Axis Schedule Panel provides a Base Update Period and two alternatives. Information such as, Estimated Utilization and Actual Utilization appear on this panel.



The alternative rates for lower performance drives provide a way for multiple drives to be 'multiplexed' through a single drive update channel. Axis Scheduling allows multiple drives to be updated by using the same amount of controller and network capacity as used in updating a single non-multiplexed drive.

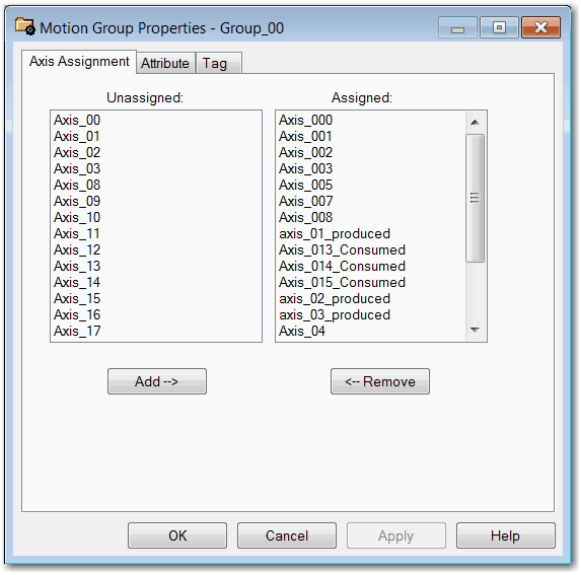
For more information on how to set up a motion group, see Create a Motion Group on page 34 for Kinetix drives and Create a Motion Group on page 62 for PowerFlex drives.

Configuring the Update Periods

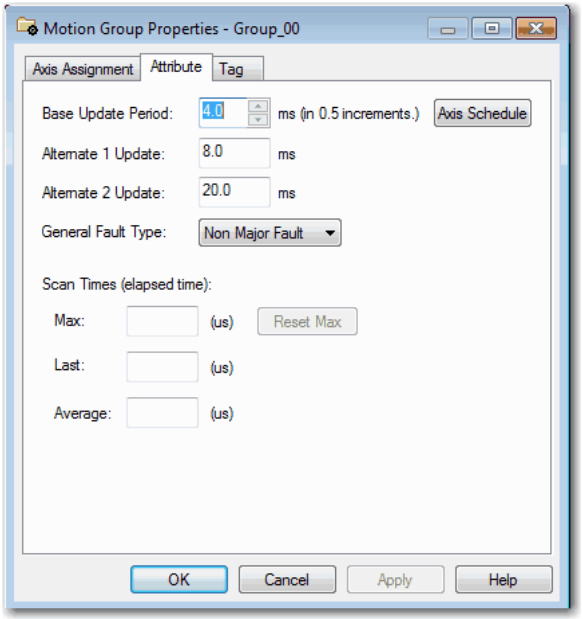
Follow these steps to configure the update periods:

1. Double-click the Motion Group.

   The Motion Group Properties dialog box appears.



2. Assign axes to the group.
3. Click Apply.
4. Go to the Attribute tab.

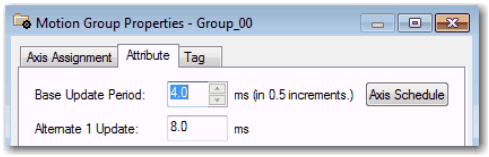


5. Choose a Base Update Period.

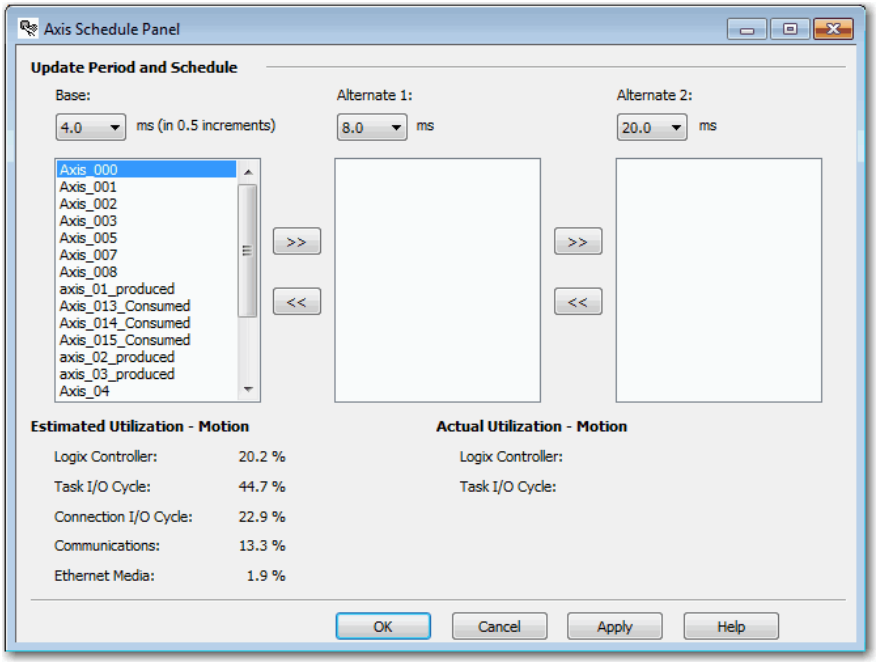
In this example, the Base Update Period is 4.0 ms and the Alternate 1 and 2 Update Periods are 8 ms and 20 ms. The base period acts as the anchor value for the axis scheduling feature.

The Alternate Update Periods are multiples of the base. You can edit the Base Update Period when the controller is offline and is read-only when the controller is online. The alternate rates on the Attribute tab are read only.

6. Click the Axis Schedule to go to the Axis Schedule Panel.



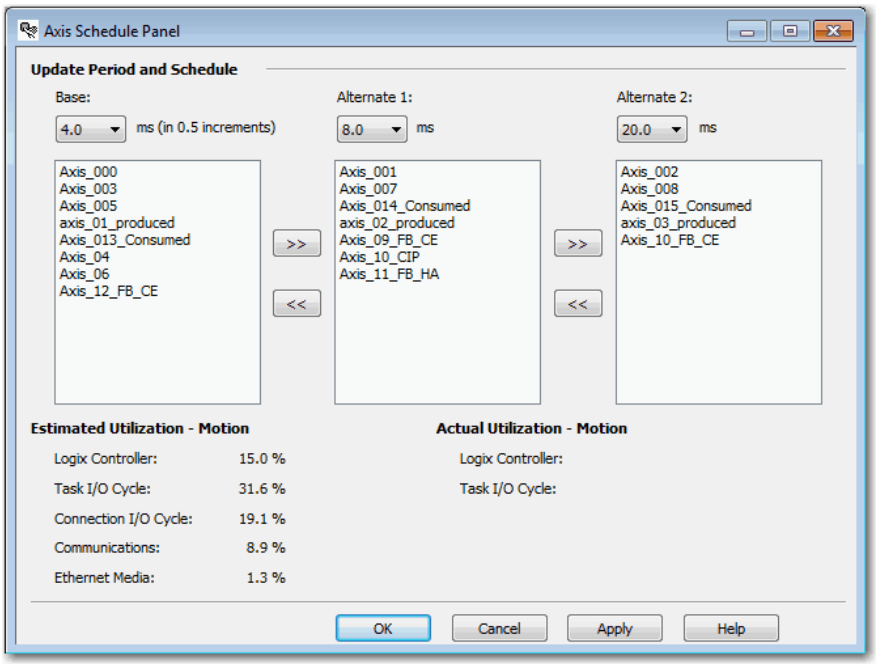
The Axis Schedule Panel appears.



The axes that you assigned in the Axis Assignment tab appear in the Base column.

7. Use the positioning arrows to assign the axes to the Alternate Update Periods.

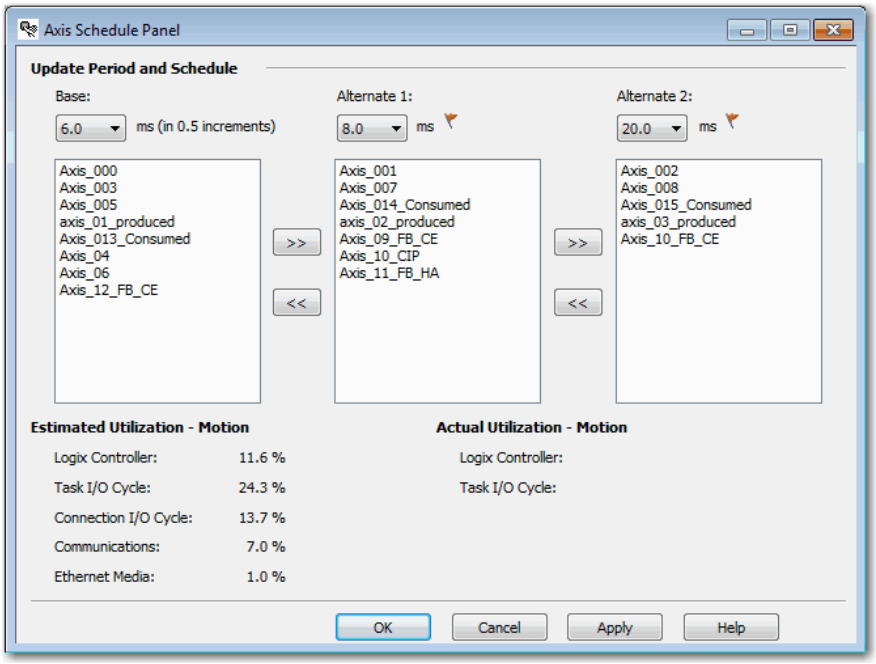
The axes appear in the Alternate columns.



8. Choose the Alternate 1 Update Period.

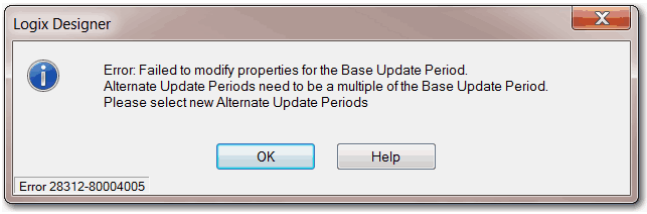
   The multipliers range from 2...32, so if the base update rate is 2.0, the values in the alternate rates are 4, 6, 8, 10, 12...32. If the base update rate is 3.0, the values are 6, 9, 12, 15, and so on.

   If you change the base rate to a non-multiple value, a warning flag appears next to an Alternate rate if you change the base rate value where the alternate rate is no longer a multiple.



Once an alternate rate is set on the Axis Schedule Panel, the Base Update Period for the group on the Attribute tab becomes disabled. You can still set the base update rate on the Axis Schedule Panel.

If you enter a value outside of that range, a warning appears and the value is set to either 0.5 or 32, depending on if you entered too small or too large of a value.

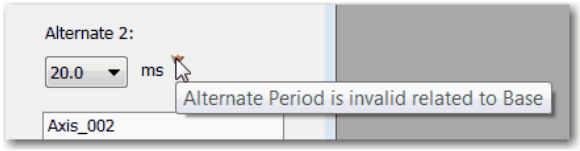

Logix Designer
Error: Failed to modify properties for the Base Update Period.
Alternate Update Periods need to be a multiple of the Base Update Period.
Please select new Alternate Update Periods
OK
Help
Error 28312-80004005

TIP If the Base Update Period is too small, the controller may not have time to execute non-motion related ladder logic. Generally, the motion task for the controller needs 1 millisecond per axis to have reasonable execution time.

As a result, the configuration sets the lower limit on the Base Update Period that is based on the number of axes in the group.

9. Choose the Alternate 2 update period.

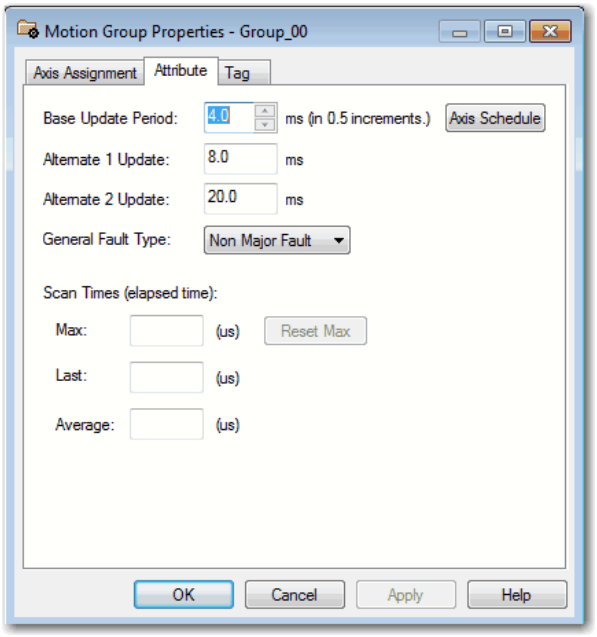
   If the base update rate is changed to a value that invalidates the alternate update rates, a warning tool tip appears.



   - If you click OK or Apply, a warning box appears that tells you that you must select valid alternate update rates before you apply any changes.

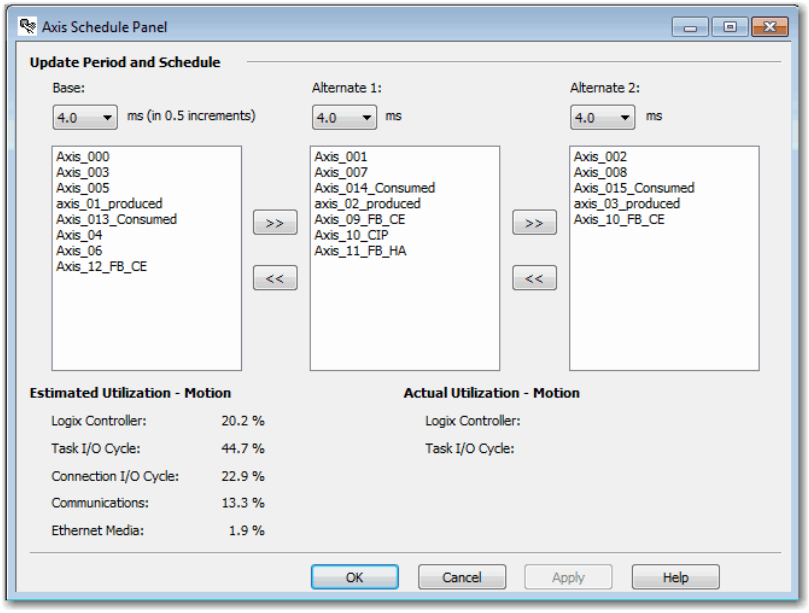
10. Update the periods as required.
11. Click Apply.

The Alternate update rates appear on the Attribute tab.

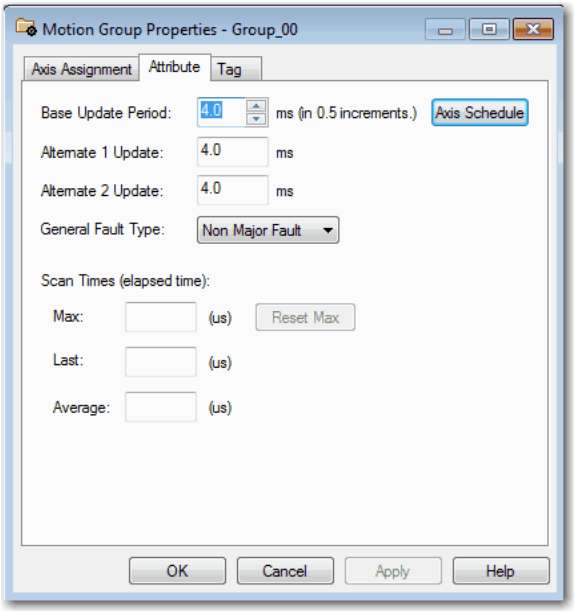


Here's another example.

1. Go to the Axis Schedule Panel and change all rates to be the same, for example 4 ms.

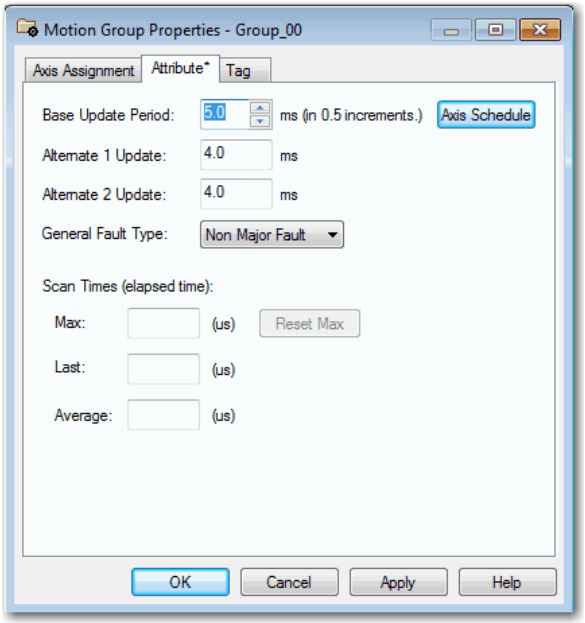


The Base Update Period on the Attribute tab becomes active.

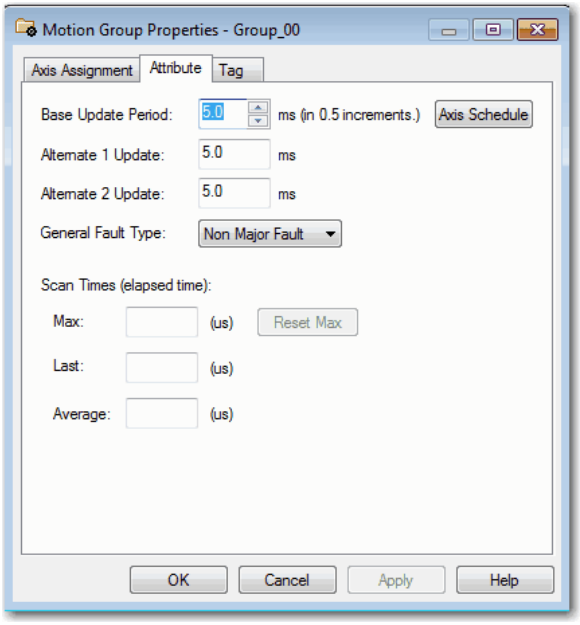


Notice that after you have made all update periods in the Axis Schedule Panel, the update period values are the same and the Base Update Period is now active. The Alternate Update Periods are always read-only.

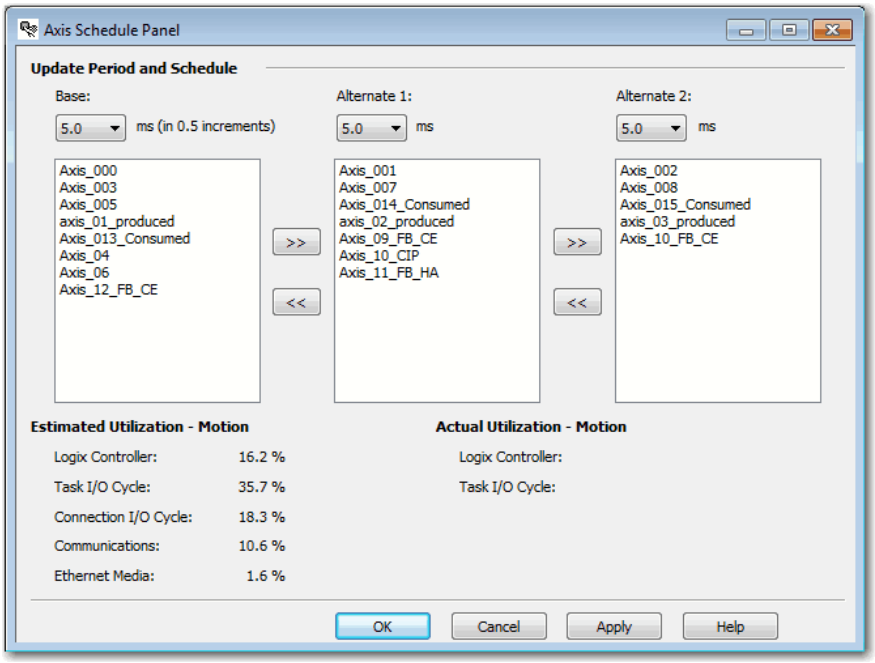
2. Change the Base Update Period.



After you click Apply (or OK), the values in the alternate fields change to match the base.

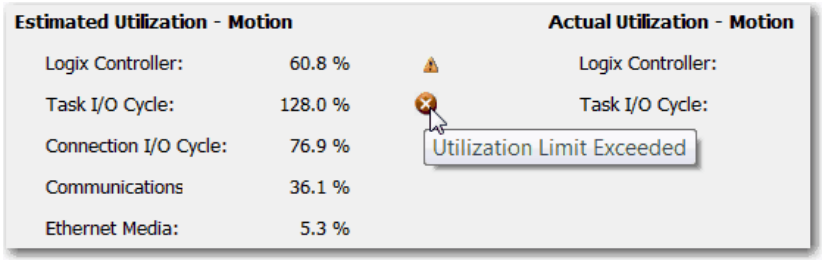


The values are also changed in the Axis Schedule Panel.



Motion Utilization

The following values are updated in real time as you change your configuration. You can see how the utilization metrics are responding to your configuration changes and you have the option to modify your configuration.



- The yellow! warning indicates that the value is at the borderline of the controller capabilities.
- The red X next to the Task I/O Cycle warning indicates that the value has reached beyond what the motion task cycle can handle.

If you find that you are reaching utilization limits and you only have the Base Update Period that is assigned to axes, start to assign axes to the Alternate Update Periods.

Table 15 - Utilization Parameter Descriptions

Parameter	Description
Estimated Utilization - Motion	Estimated utilization assumes basic default configuration with no active motion planner activity, no transmission statistics, and no cyclic read or write. The estimated percent of time the controller spends on motion while online.
Logix Controller	The estimated percentage of the Logix controller's time that is consumed by a motion task. If this value exceeds 50%, a warning icon appears. If this value exceeds 80%, an error icon appears.
Task I/O Cycle	The estimated percentage of time available in the update cycle Motion Task to process input, run motion planner, and send output to motion devices. If this value exceeds 100%, a warning icon appears. If this value exceeds (200 connection I/O cycle Cycle)%, an error icon appears.
Connection I/O Cycle	The estimated percentage of time available in the update cycle for input and output data transmission over the motion connection. If this value exceeds 80%, a warning icon appears. If the value exceeds 100%, an error icon appears.
Communications	Shows the estimated percentage of the communications controller's time that is consumed to process motion connection packets. If this values exceeds 50%, a warning icon appears. If this value exceeds 100%, an error icon appears.
Ethernet Media	Shows the estimated percentage of Ethernet media bandwidth used by motion connection packet traffic. If the value exceeds 50%, a warning icon appears. If the values exceeds 100%, an error icon appears.
Actual Utilization - Motion	Actual utilization is based on measurements that are made by the Logix controller. Actual utilization values may be substantially higher than estimated utilization values depending on factors such as active motion planner activity, transmission statistics, and cyclic read or write data.
Logix Controller	Shows the actual percentage of the Logix controller's time that is consumed by motion task.
Task I/O Cycle	Shows the actual percentage of time available in the update cycle for motion task to process input, run motion planner, and send output to motion devices.

Notes:

Configure a Project for Integrated Motion on the EtherNet/IP Network

This chapter describes how to configure an integrated motion project in the Logix Designer application.

Topic	Page
Create a Controller Project	89
Set Time Synchronization	92
Add a 1756-ENxTx Communication Module	95

IMPORTANT When you perform an import/export on a project in the RSLogix 5000 software, version 19 or earlier, the axis absolute position is not recovered on download to the controller.

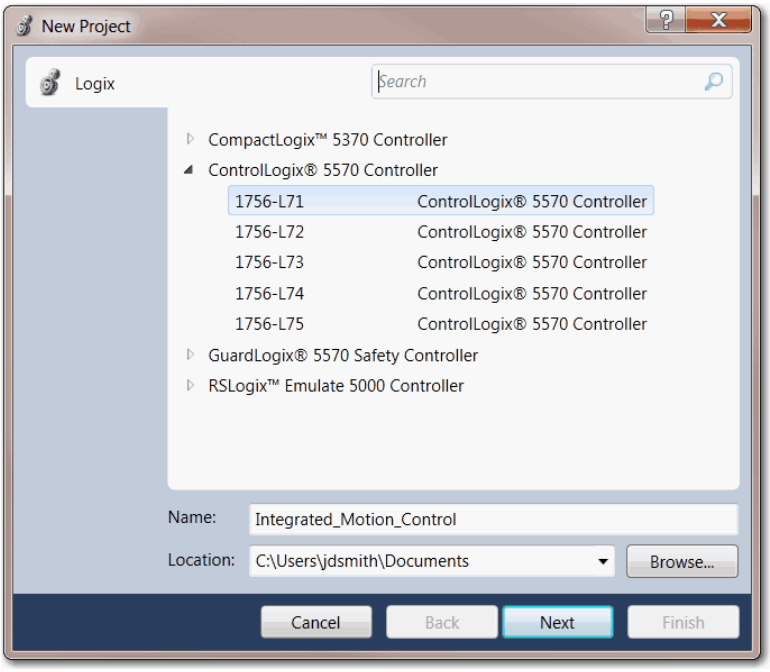
See APR Faults on page 184 for more information.

Create a Controller Project

Follow these instructions to create a project.

1. On the Studio 5000 dialog box, choose Create New Project.

2. Choose a controller, type a name, and click Next.

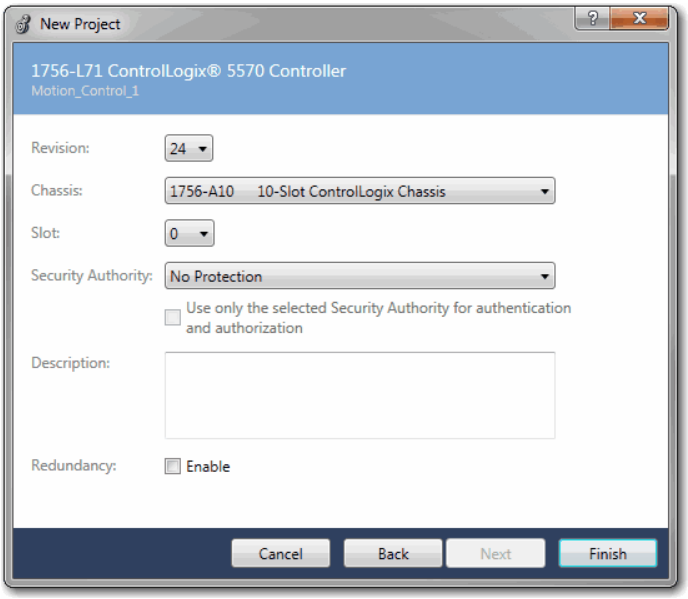


3. Type a Name for the controller.

4. Assign a location (optional).

5. Click Next.

   Project Configuration dialog box appears.

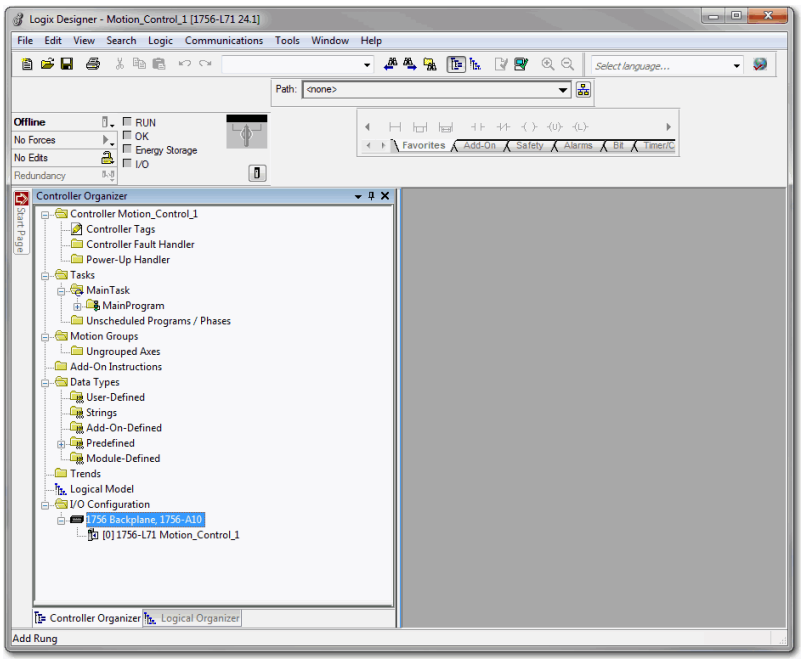


6. Choose the chassis type.

7. Assign the slot location of the controller.

8. Assign the Security Authority.
9. Type a description (optional).
10. Click Finish.

The Logix Designer application opens with new project.

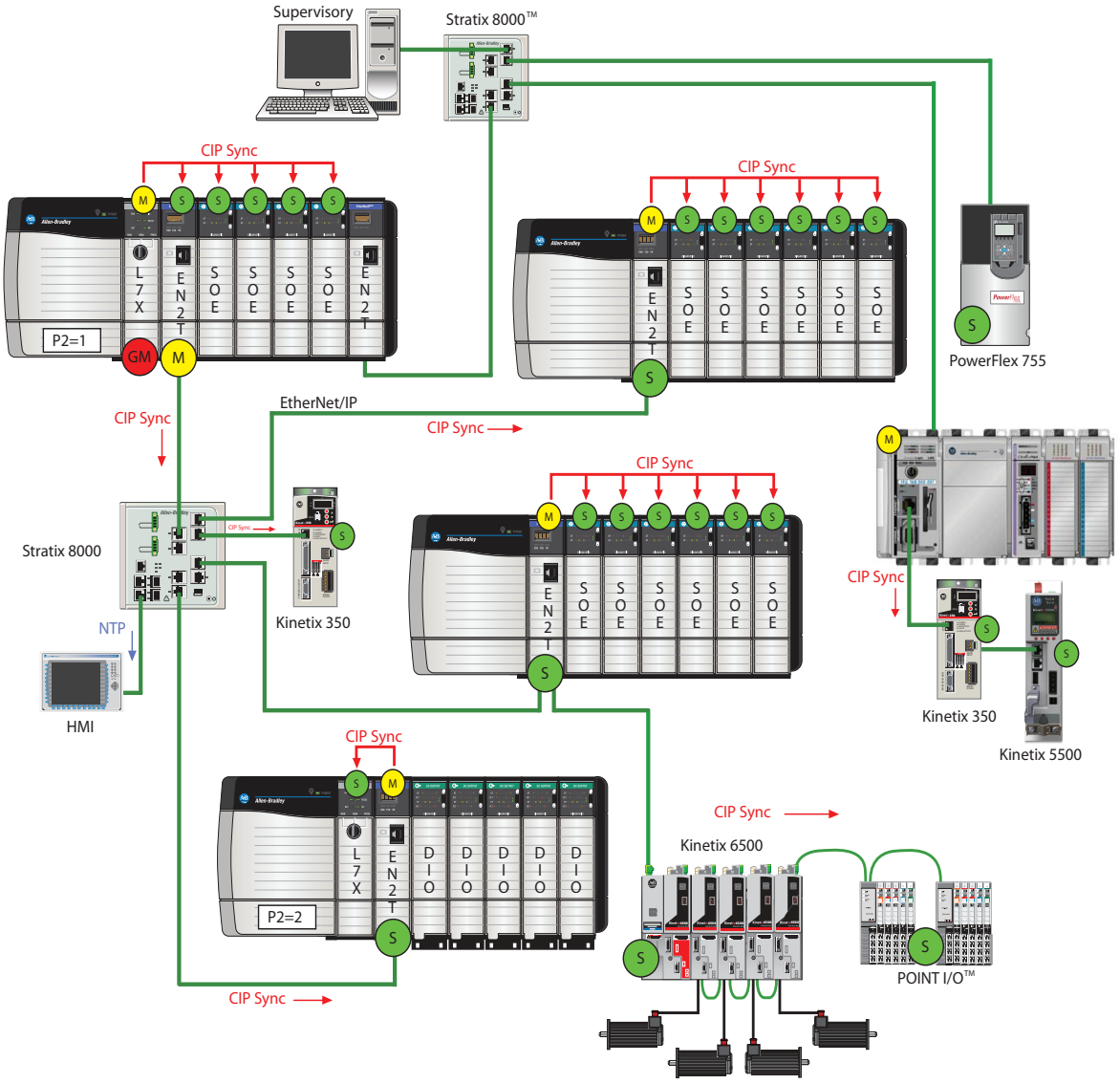


Set Time Synchronization

This technology supports highly distributed applications that require time stamping, sequence of events recording, distributed motion control, and increased control coordination. All controllers and communication modules must have time synchronization that is enabled for applications that use Integrated Motion on the EtherNet/IP network.

Time synchronization in the Logix system is called CIP Sync. CIP Sync provides a mechanism to synchronize clocks between controllers, I/O, and other devices that are connected over CIP networks and the ControlLogix or CompactLogix backplane. The device with the best clock becomes the Grandmaster time source for your system.

Figure 4 - Star Topology with the ControlLogix Controller as the Grandmaster



GM = Grandmaster (time source)

M = Master

S = Slave

P1 and P2 = Priorities — Priorities are automatically assigned based on their clock quality, which is determined by the Best Clock Algorithm. In this example, P2=1 is the best quality so it becomes the Grandmaster. If the P2=1 device loses clock quality for some reason, then P2=2 would become the Grandmaster for the system.

The Best Master Clock algorithm determines what device has the best clock. The device with the best clock becomes the Grandmaster time source for your system. All controllers and communication modules must have time synchronization that is enabled to participate in CIP Sync.

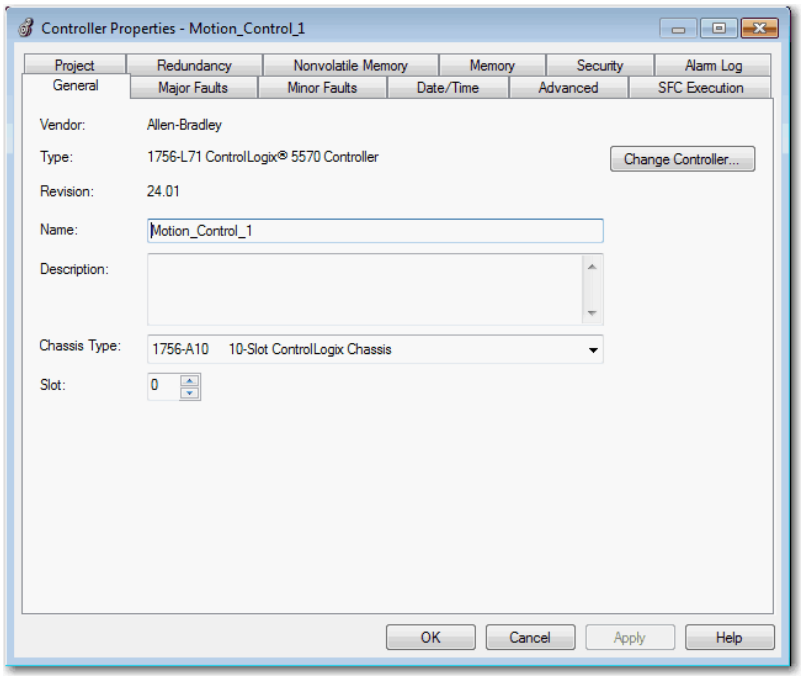
See the Integrated Architecture and CIP Sync Configuration Application Technique, publication IA-AT003, for detailed information.

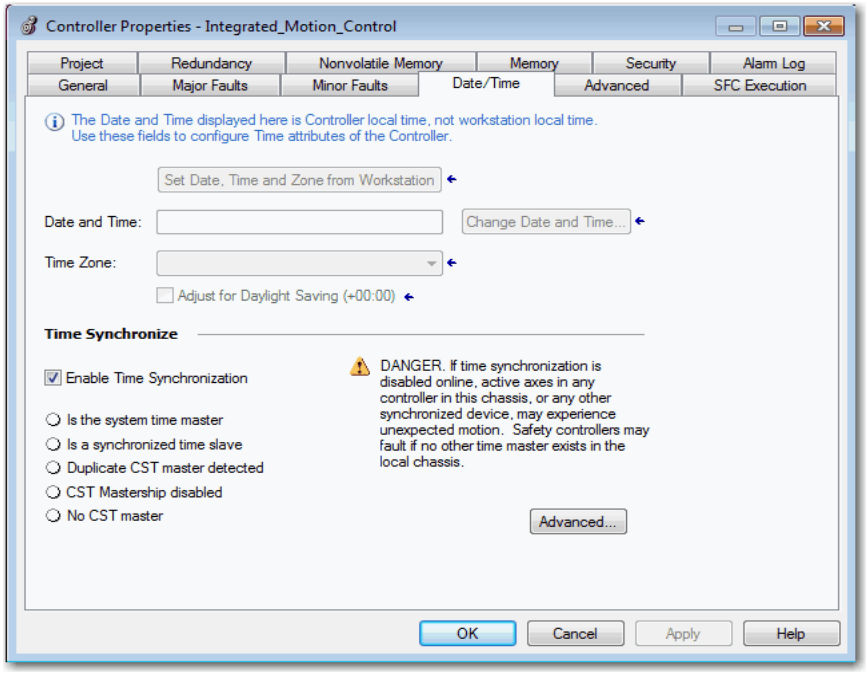
You must enable time synchronization for motion applications. Follow these instructions to enable time synchronization.

1. In the Controller Organizer, right-click the controller and choose Properties.

2. Click the Date/Time tab.

   This graphic is an example of the Controller Properties dialog box for the 1756-L71 controller.




Controller Properties - Integrated_Motion_Control
Project
Redundancy
Nonvolatile Memory
Memory
Security
Alarm Log
General
Major Faults
Minor Faults
Date/Time
Advanced
SFC Execution
The Date and Time displayed here is Controller local time, not workstation local time.
Use these fields to configure Time attributes of the Controller.
Set Date, Time and Zone from Workstation
Date and Time:
Change Date and Time...
Time Zone:
Adjust for Daylight Saving (+00:00)
Time Synchronize
Enable Time Synchronization
Is the system time master
Is a synchronized time slave
Duplicate CST master detected
CST Mastership disabled
No CST master
DANGER. If time synchronization is disabled online, active axes in any controller in this chassis, or any other synchronized device, may experience unexpected motion. Safety controllers may fault if no other time master exists in the local chassis.
Advanced...
OK
Cancel
Apply
Help

3. Check Enable Time Synchronization.
4. Click OK.

Add a 1756-EN*x*T*x* Communication Module

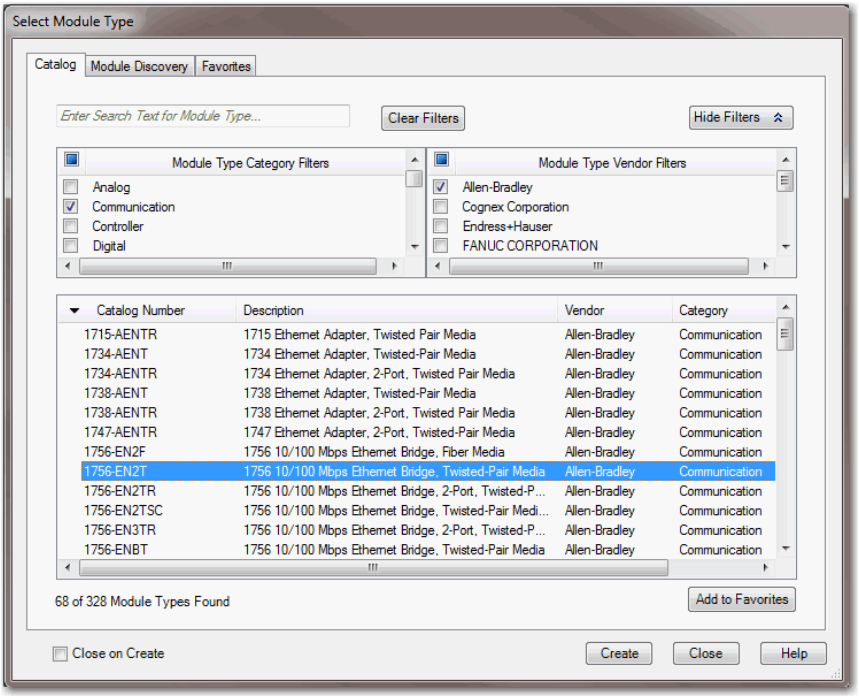
Follow these instructions to add an Ethernet communication module to your project. These modules are compatible with the CIP Sync protocol: catalog numbers 1756-EN2T, 1756-EN2F, 1756-EN2TR, and 1756-EN3TR.

IMPORTANT For all communication modules, use the firmware revision that goes with the firmware revision of your controller. See the release notes for the firmware of your controller.

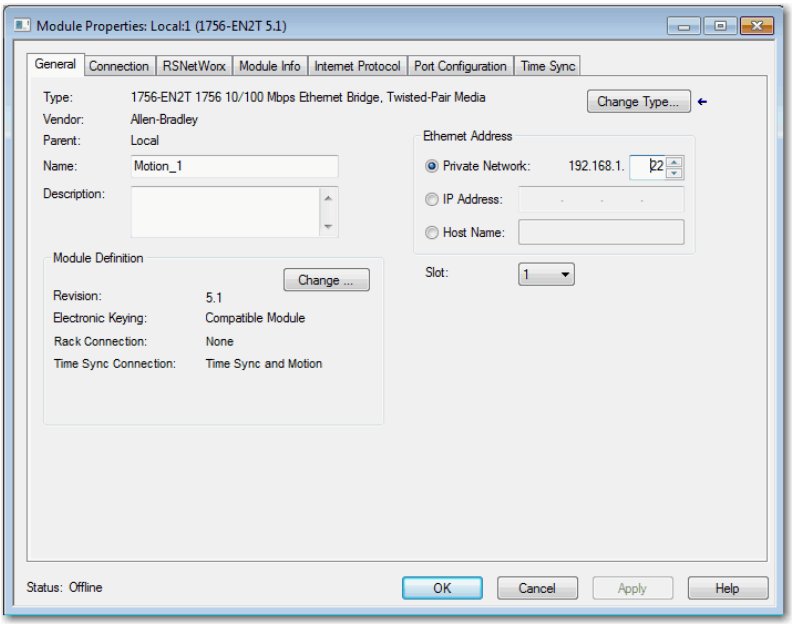
1. To add a module, right-click the backplane and choose New Module.
2. Clear the Module Type Category Filters select all checkbox.
3. Check the Communication checkbox.

   On the Select Module Type dialog box, you can filter to the exact type of module you are looking for, which makes your search faster.

4. Under Communications, select the 1756-EN*x*T*x* module and click OK.



The New Module configuration tabs appear.



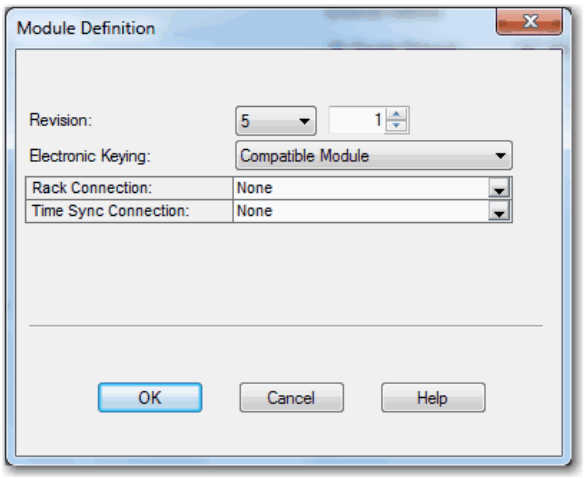
5. Type a name for the module.
6. If you want, type a description.
7. Assign the Ethernet address of the 1756-EN*x*T*x* module.

   For information on creating an Ethernet network and setting IP addresses for the communication and motion modules, see these manuals:

   - EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001
   - PowerFlex 755 Drive Embedded EtherNet/IP Adapter User Manual, publication, 750COM-UM001
   - Knowledgebase Technote # 66326
   - Converged Plantwide Ethernet (CPwE) Design and Implementation Guide, publication ENET-TD001

8. Assign the slot for the module.
9. In the module definition area, click Change.

10. Choose an Electronic Keying option.

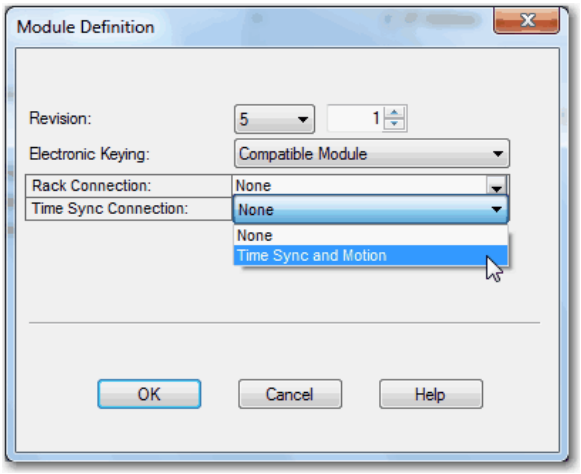


ATTENTION: The electronic keying feature automatically compares the expected module, as shown in the configuration tree, to the physical module before communication begins.
When you are using motion modules, set the electronic keying to either `Exact Match' or `Compatible Keying'.

Never use `Disable Keying' with 1756-EN*x*T*x* communication and motion modules.

For more information about electronic keying see the ControlLogix Controller User Manual, publication 1756-UM001.

11. Choose Time Sync and Motion.



IMPORTANT For CIP Sync time coordination to work in motion control, you must set the Time Sync Connection to Time Sync and Motion on all 1756-EN*x*T*x* communication modules. The CIP Sync protocol is what enables motion control on the EtherNet/IP network.

The Time Sync and Motion selection is available only for firmware version 3.0 and later. You must be offline to change the Time Sync and Motion selection.

If you are online at a major revision of 1 or 2, you can only change the revision to a 1 or 2. You must go offline to change the module to revision 3 or 4 and return to revision 1 or 2.

IMPORTANT For the CompactLogix 5370 controllers: 1769-L18ERM, 1769-L27ERM, 1769-L30ERM, 1769-L33ERM, and 1769-L36ERM, the embedded dualport Ethernet is automatically set with Time Sync Connection= Time Sync and Motion.

Check the `Enable Time Synchronization' checkbox on the controller time/date tab to enable Integrated Motion.

12. Click OK.

IMPORTANT If you have not enabled time synchronization, you get errors when you try to associate an axis.

Configuration Examples for a Kinetix Drive

This chapter provides three typical axis configuration examples when using a Kinetix 6500 drive. The differences between the Kinetix drives are noted where applicable.

Topic	Page
Example 1: Position Loop with Motor Feedback Only	99
Example 2: Position Loop with Dual Feedback	103
Example 3: Feedback Only	108
Example 4: Kinetix 5500 Drive, Velocity Loop with Motor Feedback	112
Example 5: Kinetix 350 Drive, Position Loop with Motor Feedback	116

For examples of configuring the Kinetix 5700 drive, see the Kinetix 5700 Multi-axis Servo Drives User Manual, publication 2198-UM002.

Example 1: Position Loop with Motor Feedback Only

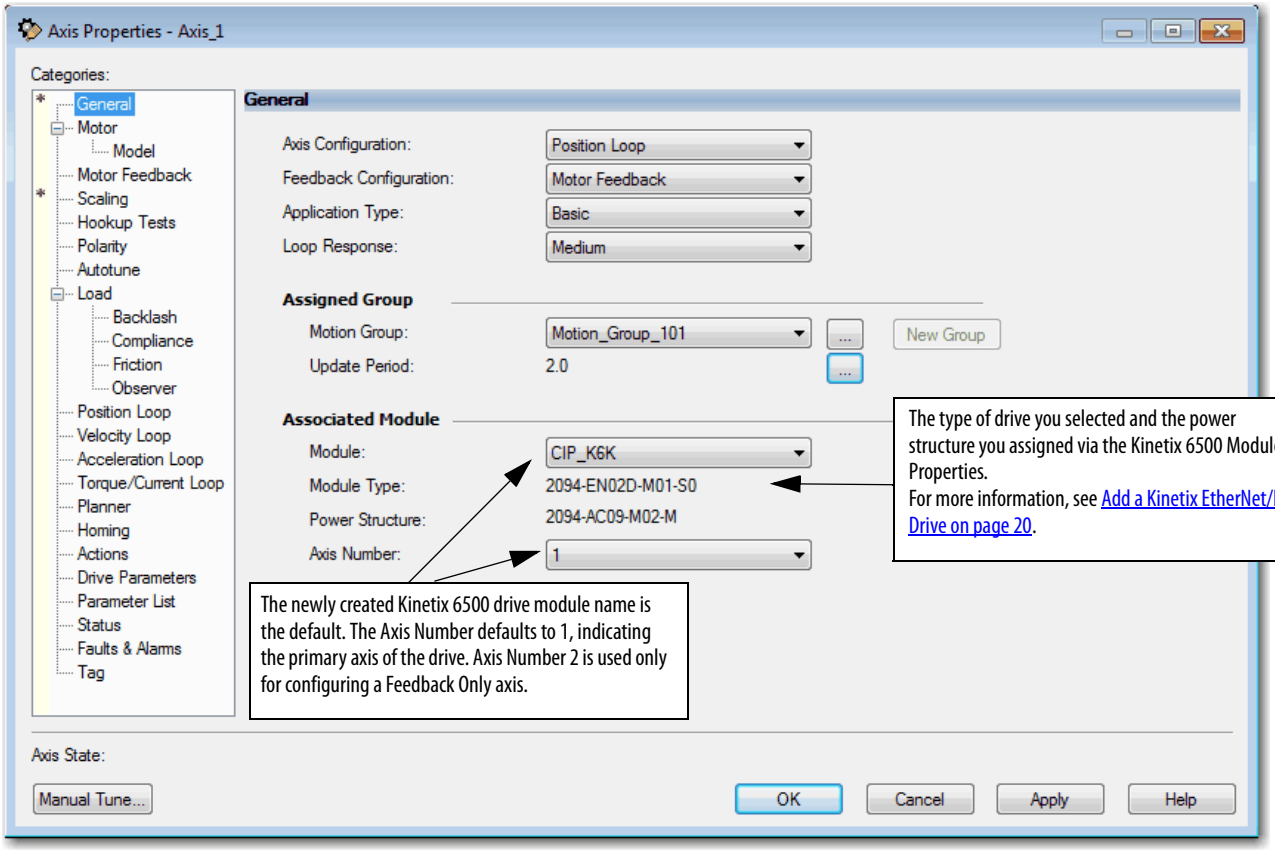
In this example, you create an AXIS_CIP_DRIVE and a Kinetix 6500 drive, which includes the control module and a power structure. You then connect the motor feedback cable to the Motor Feedback port of the Kinetix 6500 drive.

1. Once you have created an AXIS_CIP_DRIVE, open the Axis Properties.
2. From the Axis Configuration pull-down menu, choose Position Loop.
3. From the Feedback Configuration pull-down menu, choose Motor Feedback.

   The axis and feedback configurations determine the control mode.

For more information on the control modes, see the Integrated Motion on the EtherNet/IP network Reference Manual, publication MOTION-RM003.

Example 1: General Dialog Box, Position Loop with Motor Feedback Only



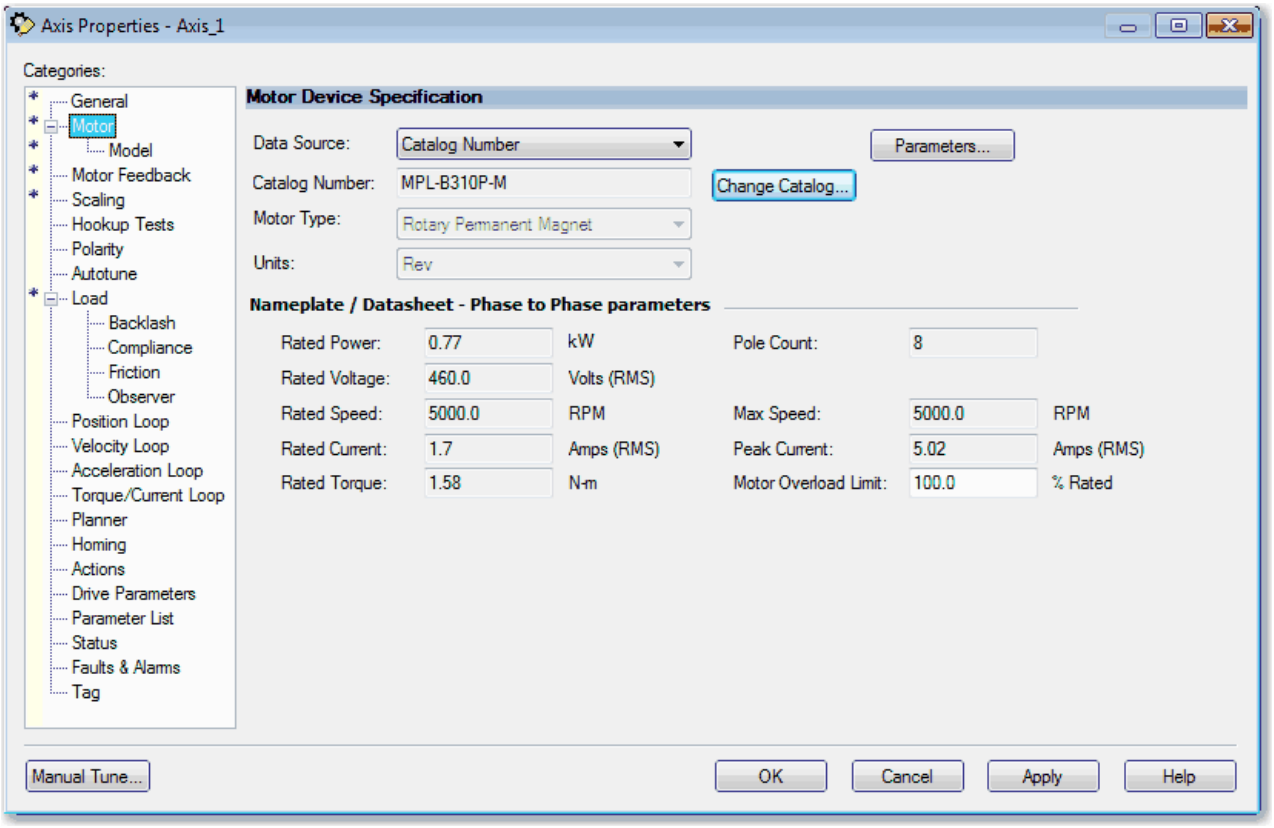
TIP After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information will be set to default values. This change can cause some previously entered data to be reset back to its default setting.

When you select the Position Loop with Motor Feedback, the Motor and Motor Feedback dialog boxes become available.

4. Choose Catalog Number as the Motor Data Source.
5. Click Change Catalog and choose your motor.

In this case, a MPL-B310P-M motor was chosen.

Example 1: Position Loop with Motor Feedback Only, Motor Dialog Box

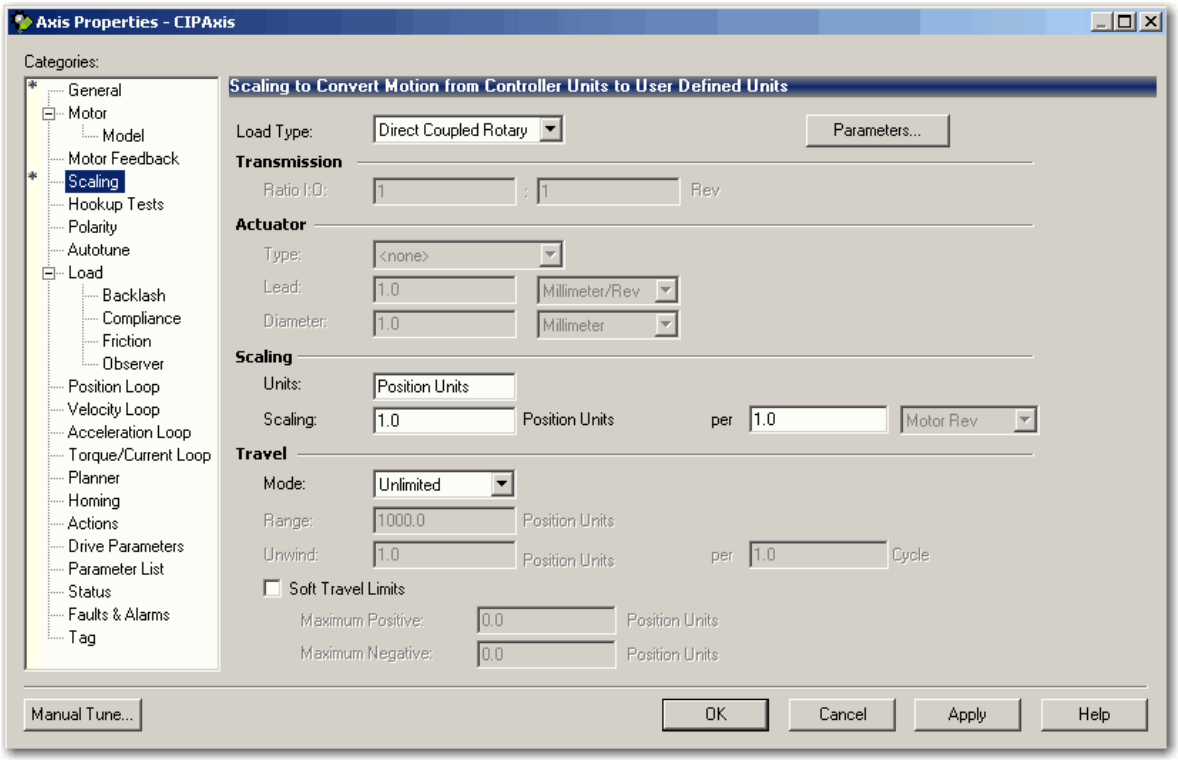


When you select the Catalog Number for the motor specification, the MPL-B310P-M motor is in the Motion Database. The specification data for this motor is automatically entered for you.

If the motor you are using is not in the Change Catalog list, then it is not in the Motion Database. You have to input the specification data or add a custom motor to the Motion Database that can be selected.

For more information, see Choose Nameplate on page 41.

Example 1: Position Loop with Motor Feedback Only, Scaling Dialog Box



6. Choose the Load Type.
7. Enter the Scaling Units.
8. Choose the Travel Mode.

   For more information about Scaling, see Scaling Dialog Box on page 146.
9. Click Apply.

   You are now finished configuring the axis for Position Loop with Motor Feedback.

Example 2: Position Loop with Dual Feedback

In this example, you create an AXIS_CIP_DRIVE and a Kinetix 6500 drive, which includes the control module and a power structure. You need to configure both feedback ports. You need to have two feedback cables that are connected to the Kinetix 6500 drive for one axis.

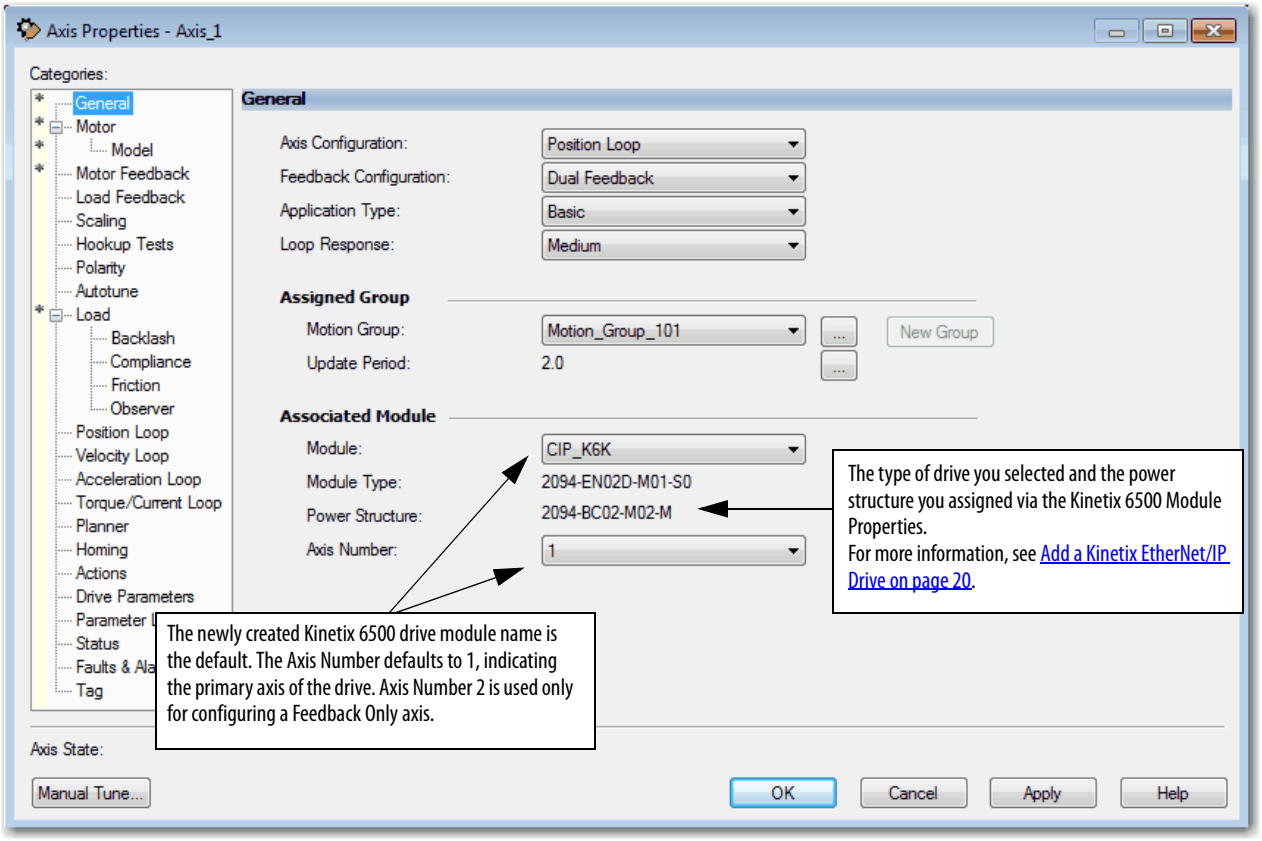
You connect the Motor Feedback cable to the Motor Feedback port, and the Load Feedback cable to the Aux Feedback port of the Kinetix 6500 drive.

1. Once you have created an AXIS_CIP_DRIVE, open the Axis Properties.
2. From the Axis Configuration pull-down menu, choose Position Loop.
3. From the Feedback Configuration pull-down menu, choose Dual Feedback.

   The axis and feedback configurations determine the control mode.

   For more information on the control modes, see the Integrated Motion on the EtherNet/IP network Reference Manual, publication MOTION-RM003.

Example 2: Position Loop with Dual Feedback, General Dialog Box



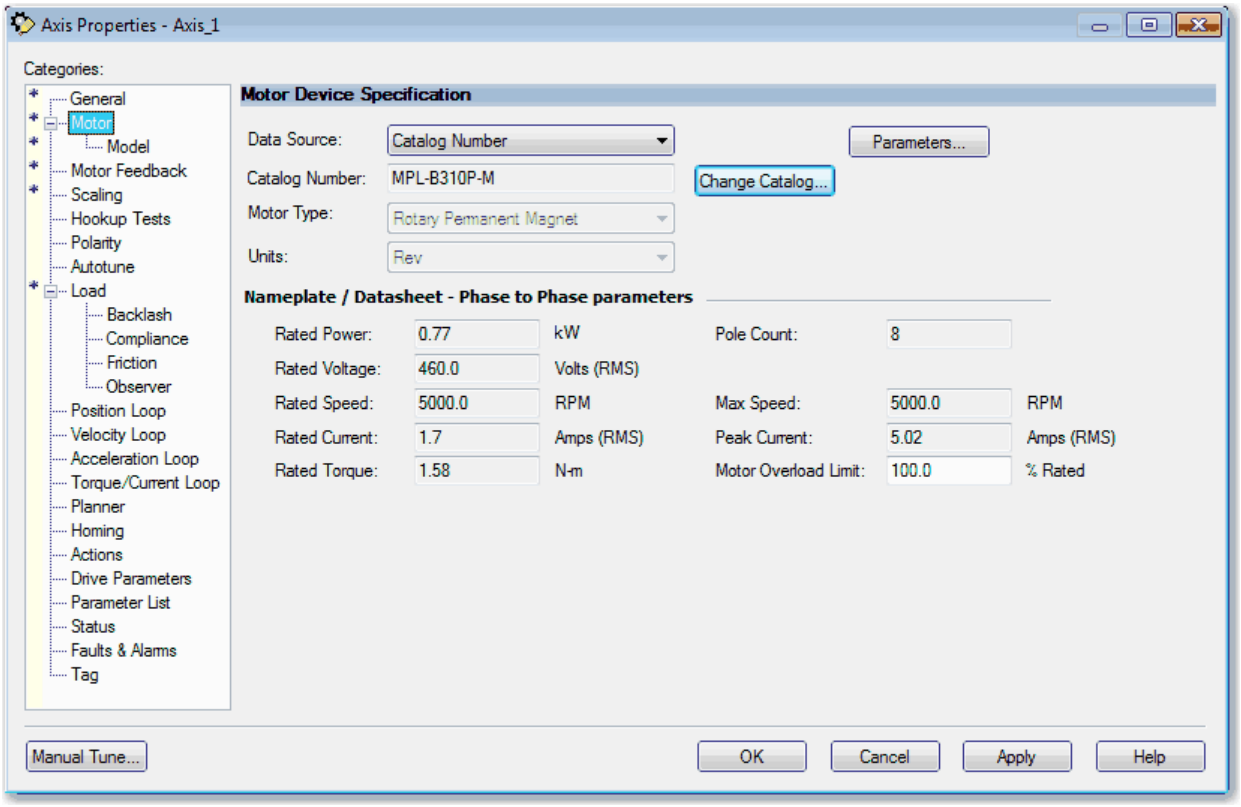
IMPORTANT After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information will be set to default values. This change can cause some previously entered data to be reset back to its default setting.

Now that you defined the axis as being a Position Loop with Dual Feedback axis, the Motor, Motor Feedback, and Load dialog boxes become available.

4. From the Data Source pull-down menu, choose Catalog Number.
5. Click Change Catalog and choose your motor.

   In this case, a MPL-B310P-M motor was chosen.

Example 2: Position Loop with Dual Feedback, Motor Dialog Box



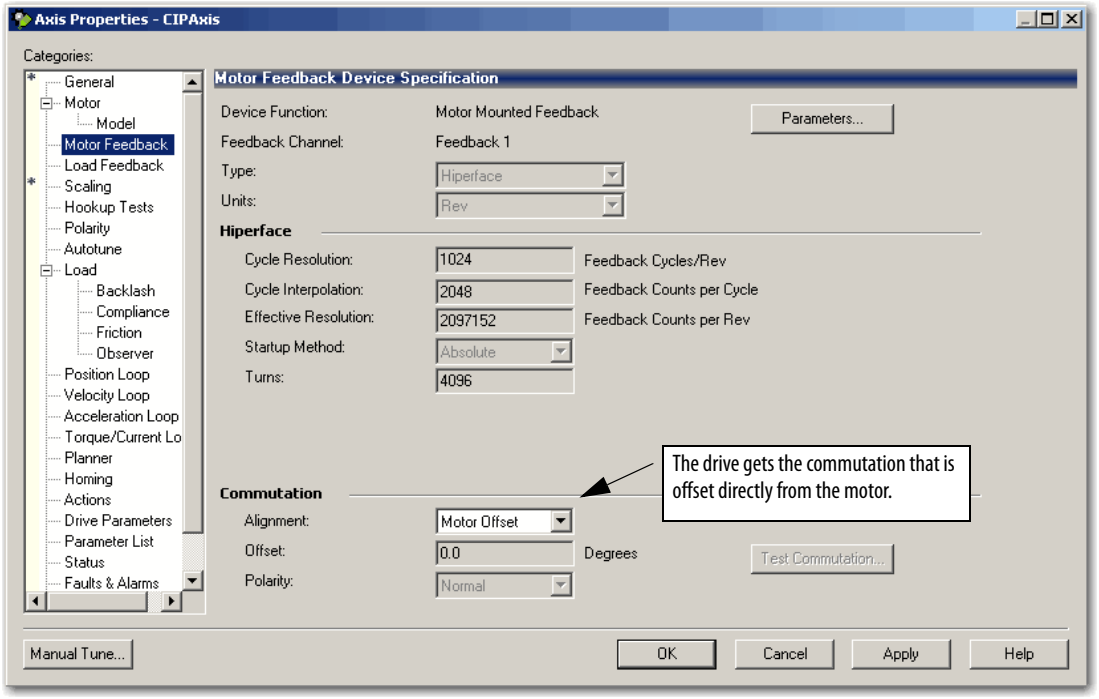
When you select the Data Source for the motor specification, the MPL-B310P-M motor is in the Motion Database, so you can select it by Catalog Number. Notice that the specification data for this motor is automatically entered for you.

If the motor you are using is not in the Change Catalog list, then it is not in the Motion Database. You need to input the specification data.

For more information, see Choose Nameplate on page 41.

On the Motor Feedback dialog box, the information is automatically filed in based on your selections on the Motor dialog box.

Example 2: Position Loop with Dual Feedback, Motor Feedback Dialog Box

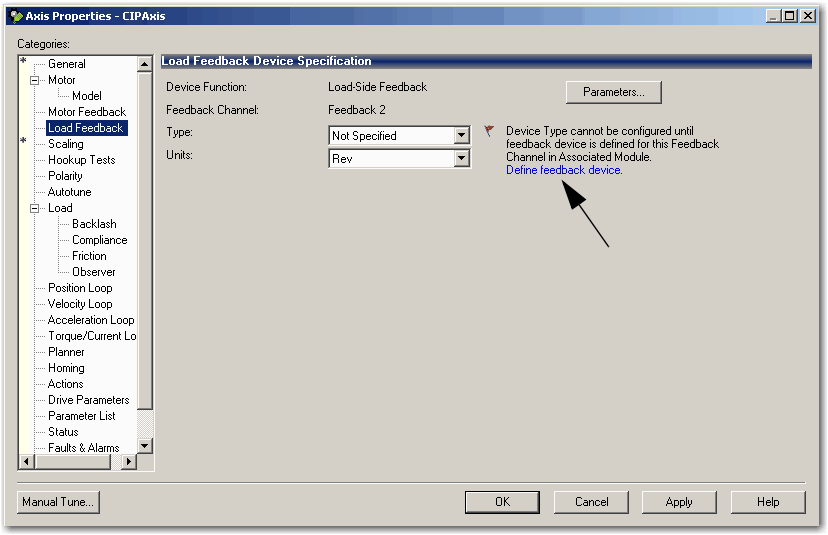


For information about Commutation, see Assign Motor Feedback on page 43 and Commutation Test on page 156.

The axis is now configured as the primary feedback. The next task is to configure Feedback 2 on the Load Feedback dialog box.

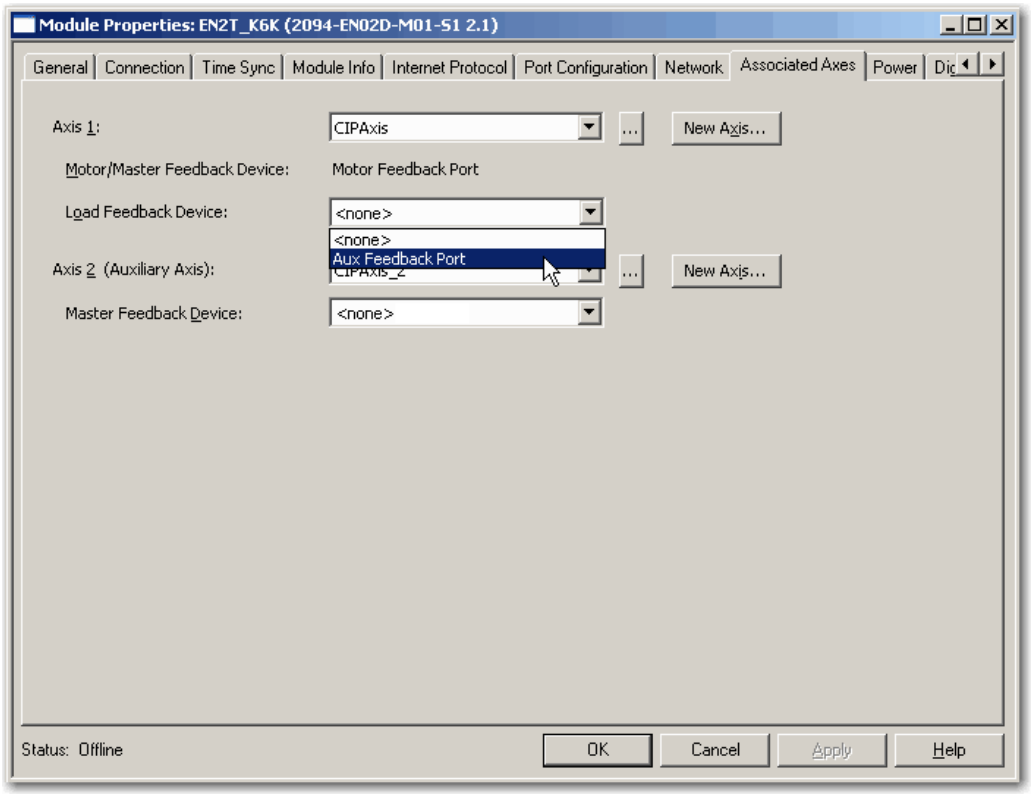
6. Click the Define feedback device link or go to the Module Properties of the drive to assign the Load Feedback device.

Example 2: Position Loop with Dual Feedback, Load Feedback Dialog Box, Load-side Feedback



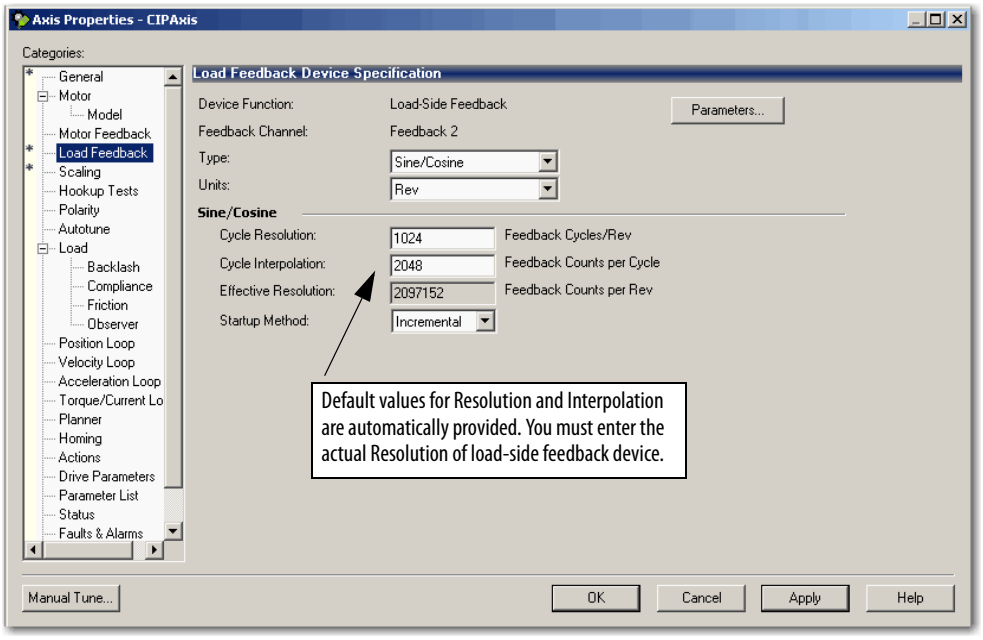
7. From the Load Feedback Device pull-down menu, choose Aux Feedback Port.
8. Click OK to apply your changes and return to the Load Feedback dialog box.

Example 2: Kinetix 6500 Module Properties, Associated Axis Tab

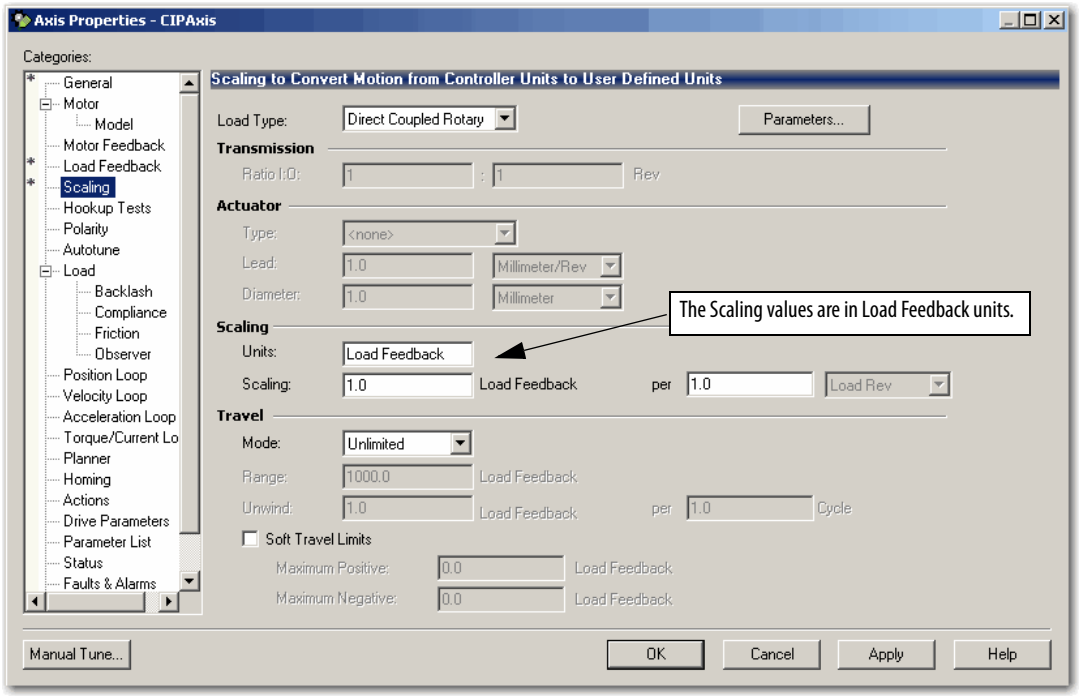


9. Choose the Feedback Type and Units.

Example 2: Position Loop with Dual Feedback, Load Feedback Dialog Box



Example 2: Position Loop with Dual Feedback, Scaling Dialog Box



You are now finished configuring the axis as Position Loop axis with Dual Feedback.

10. Click OK to apply your changes and close Axis Properties.

Example 3: Feedback Only

In this example, you create a half axis AXIS_CIP_DRIVE type by using the AUX Feedback port of the drive for Master Feedback. You need to connect the Master Feedback device cable to the Aux Feedback port of the Kinetix 6500 drive.

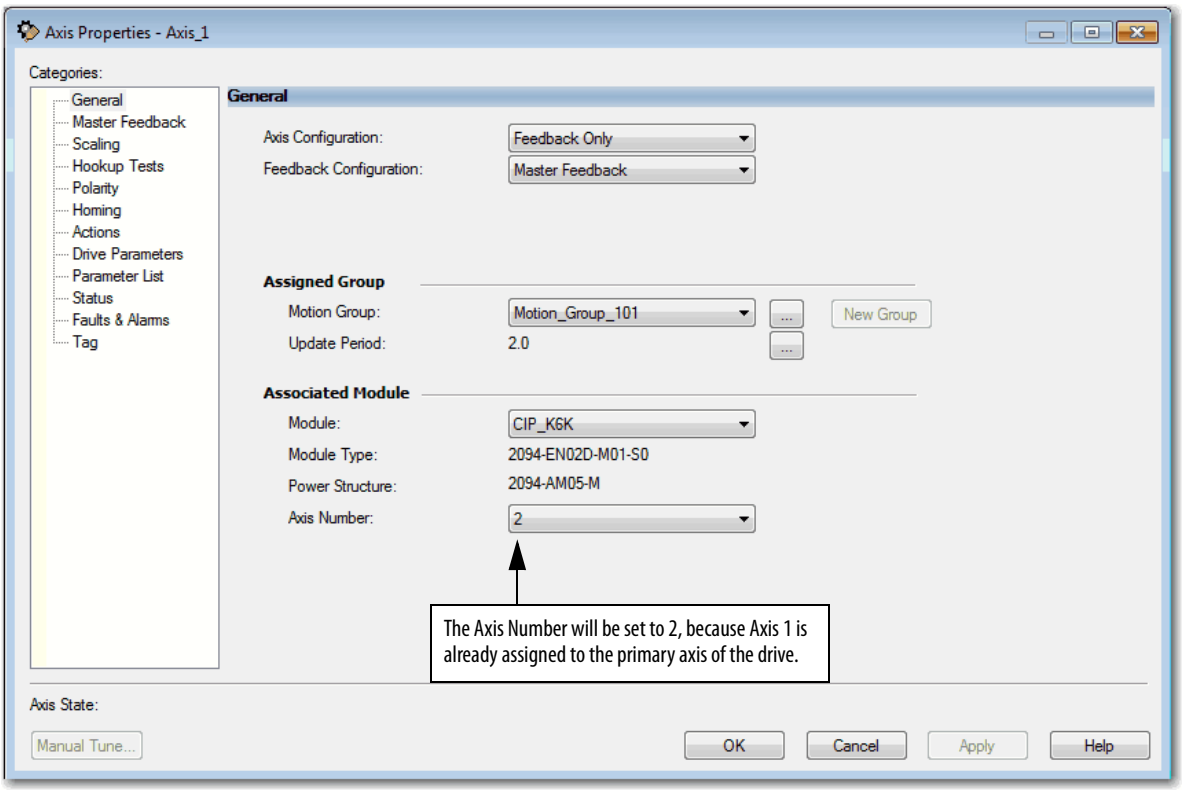
TIP You can use feedback only axes, for example, as a master reference for gearing, with PCAM moves, and MAOC output CAMs.

1. From the Axis Configuration pull-down menu, choose Feedback Only.
2. From the Feedback Configuration pull-down menu, choose Master Feedback.

   This determines the control mode.

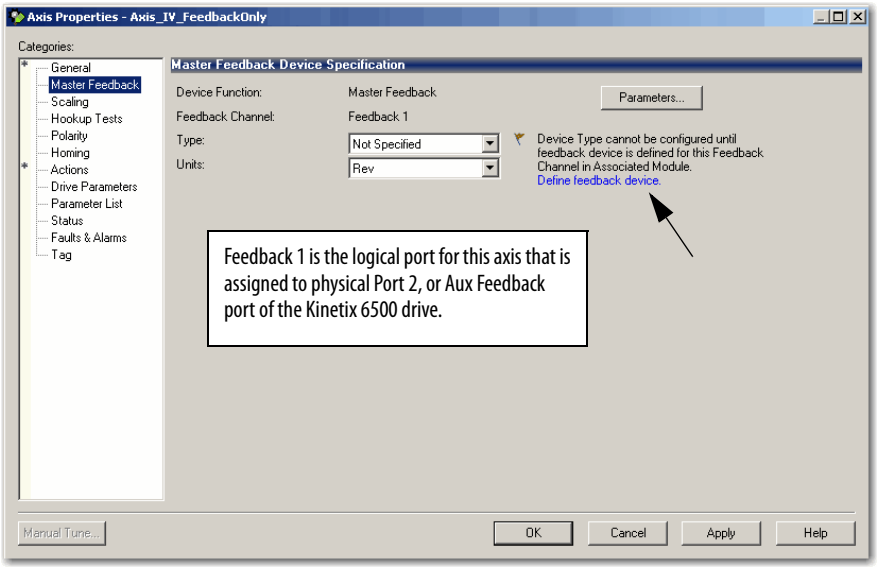
   For more information, see the Integrated Motion on the EtherNet/IP network Reference Manual, publication MOTION-RM003.
3. From the Module pull-down menu, choose the associated module that you want to use for the Master Feedback device.

Example 3: Feedback Only with Master Feedback, General Dialog Box



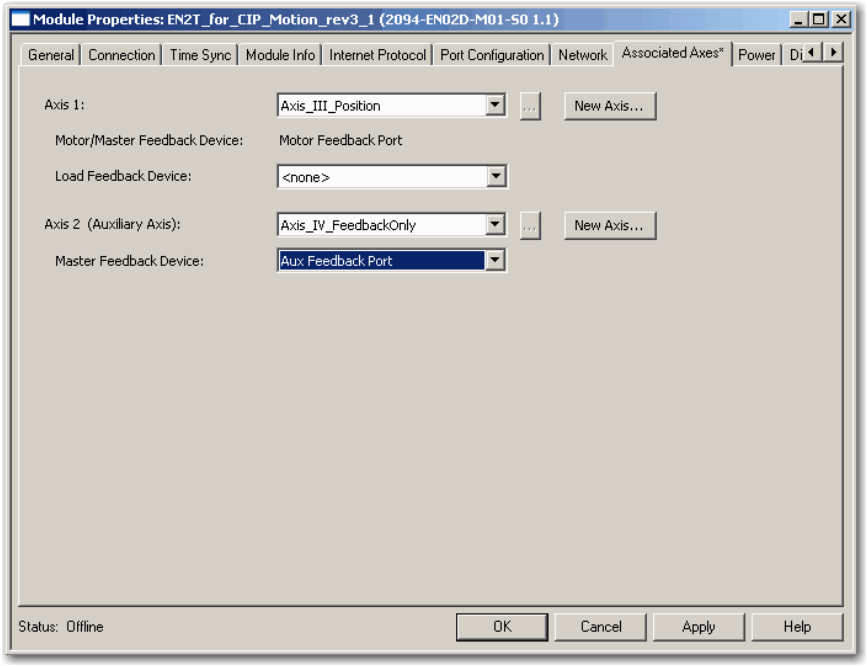
4. Click the Define feedback device link to associate the drive with the axis.

Example 3: Feedback Only with Master Feedback, Master Feedback Dialog Box



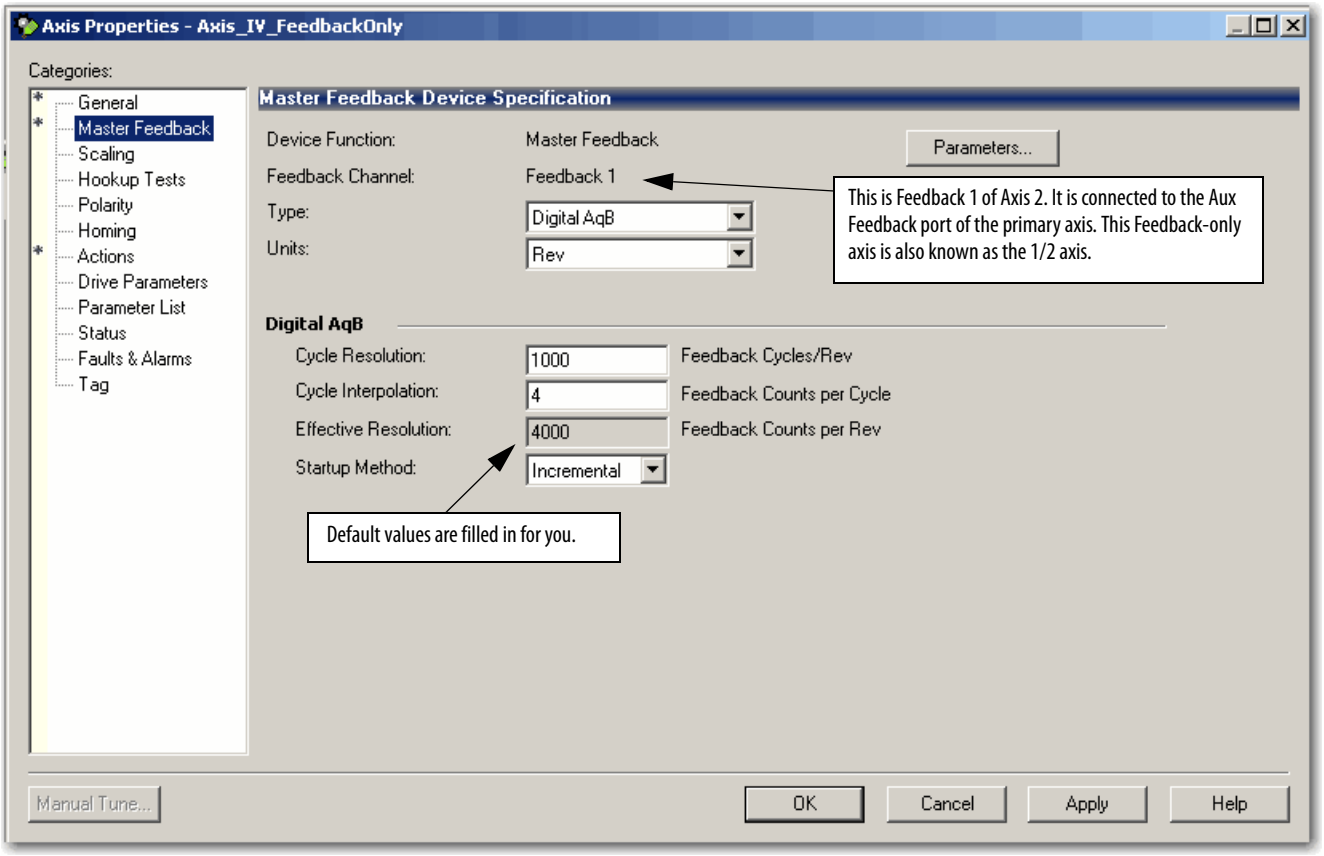
5. From the Axis 2 (Auxiliary Axis) pull-down menu, choose Axis_IV_Feedback Only to associate the axis.

Example 3: Master Feedback Dialog Box



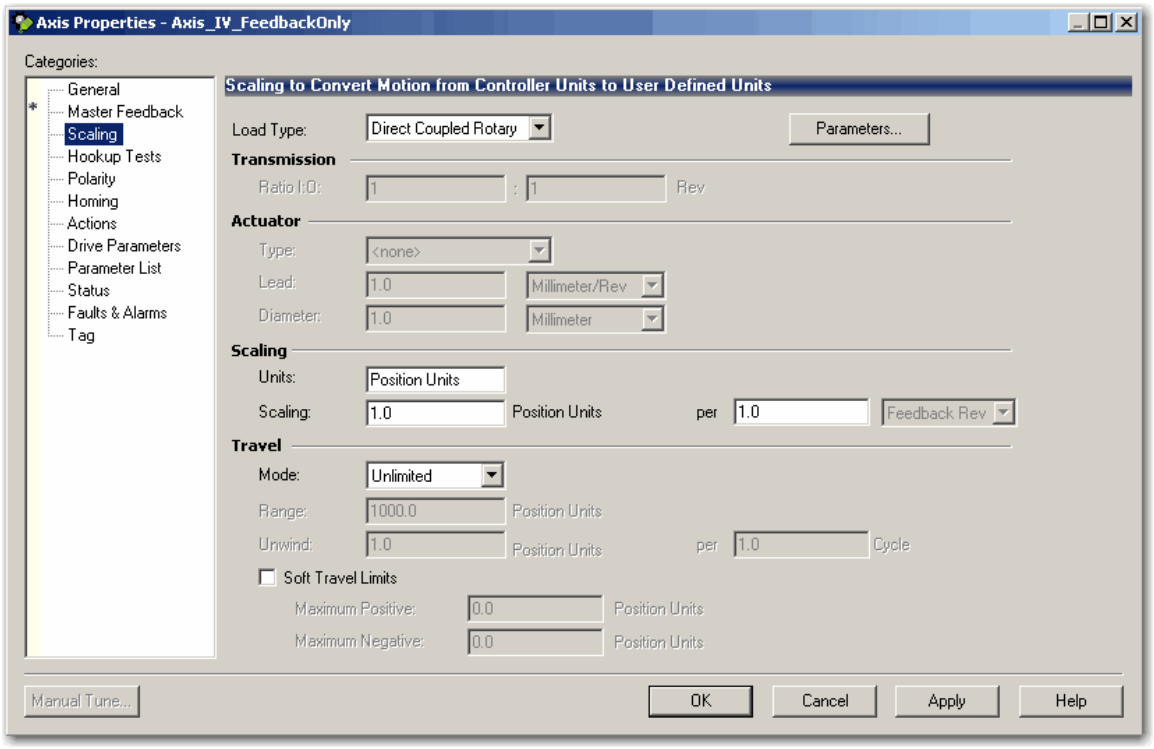
6. From the Master Feedback Device pull-down menu, choose Aux Feedback Port to map the port to the device.
7. Click OK to apply your changes and return to Axis Properties.

Example 3: Feedback Only with Master Feedback, Master Feedback Dialog Box



8. From the Type pull-down menu, choose Digital AqB as the feedback type.
9. From the Units pull-down menu, choose Rev.
10. In the appropriate field, type the resolutions of your specific feedback device.

Example 3: Feedback Only with Master Feedback, Scaling Dialog Box



11. From the Load Type pull-down menu, choose your load type.
12. Enter the Scaling Units.
13. From the Mode pull-down menu, choose your Travel mode.

    For more information about Scaling, see Scaling Dialog Box on page 146.
14. Click Apply.

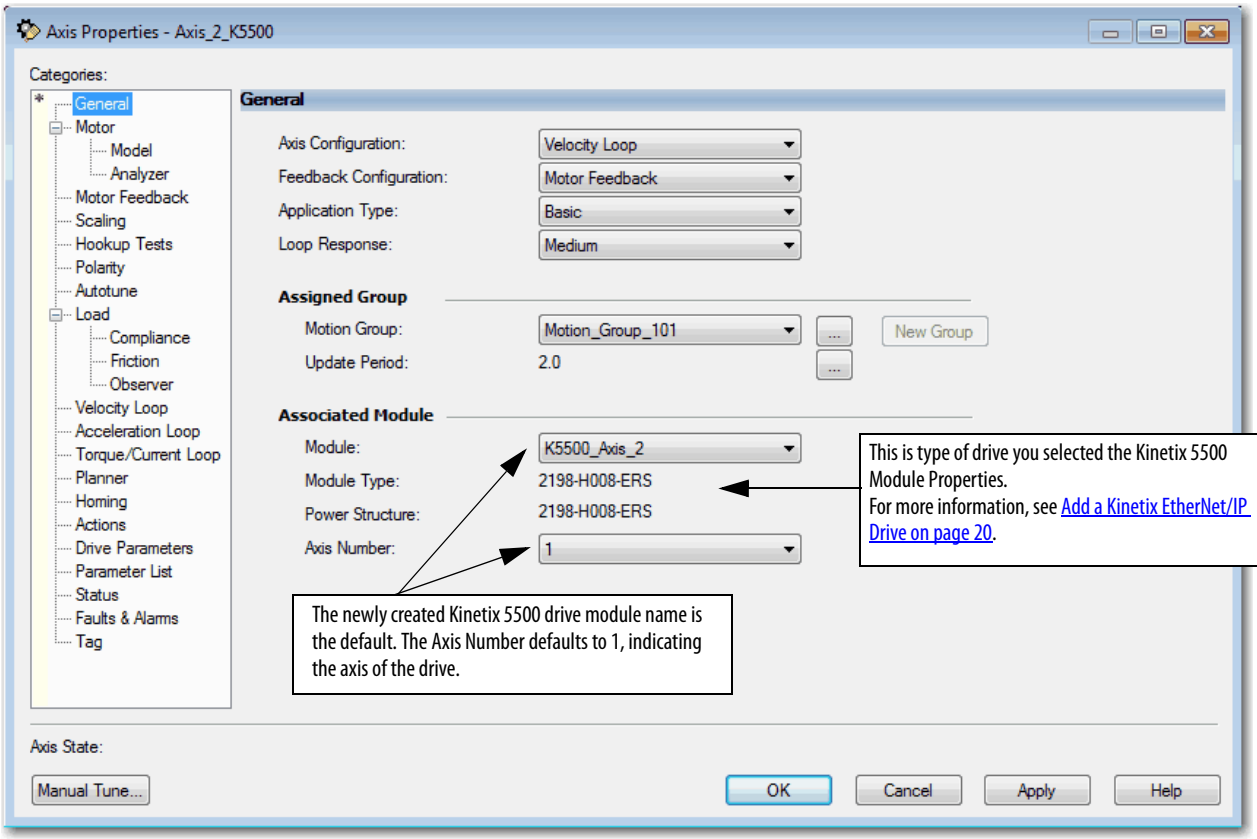
    You are now finished configuring an axis for Feedback Only.

Example 4: Kinetix 5500 Drive, Velocity Loop with Motor Feedback

In this example, you are configuring a Kinetix 5500 servo drive, catalog number 2098-H025-ERS, with motor feedback by using a Rotary Permanent Magnet motor, catalog number VPL-A1001M-P.

You will need to connect the Motor Feedback cable to the Motor Feedback port of the Kinetix 5500 drive and then configure the feedback port.

1. Once you have added the drive to your project and created an AXIS_CIP_DRIVE, open the Axis Properties.

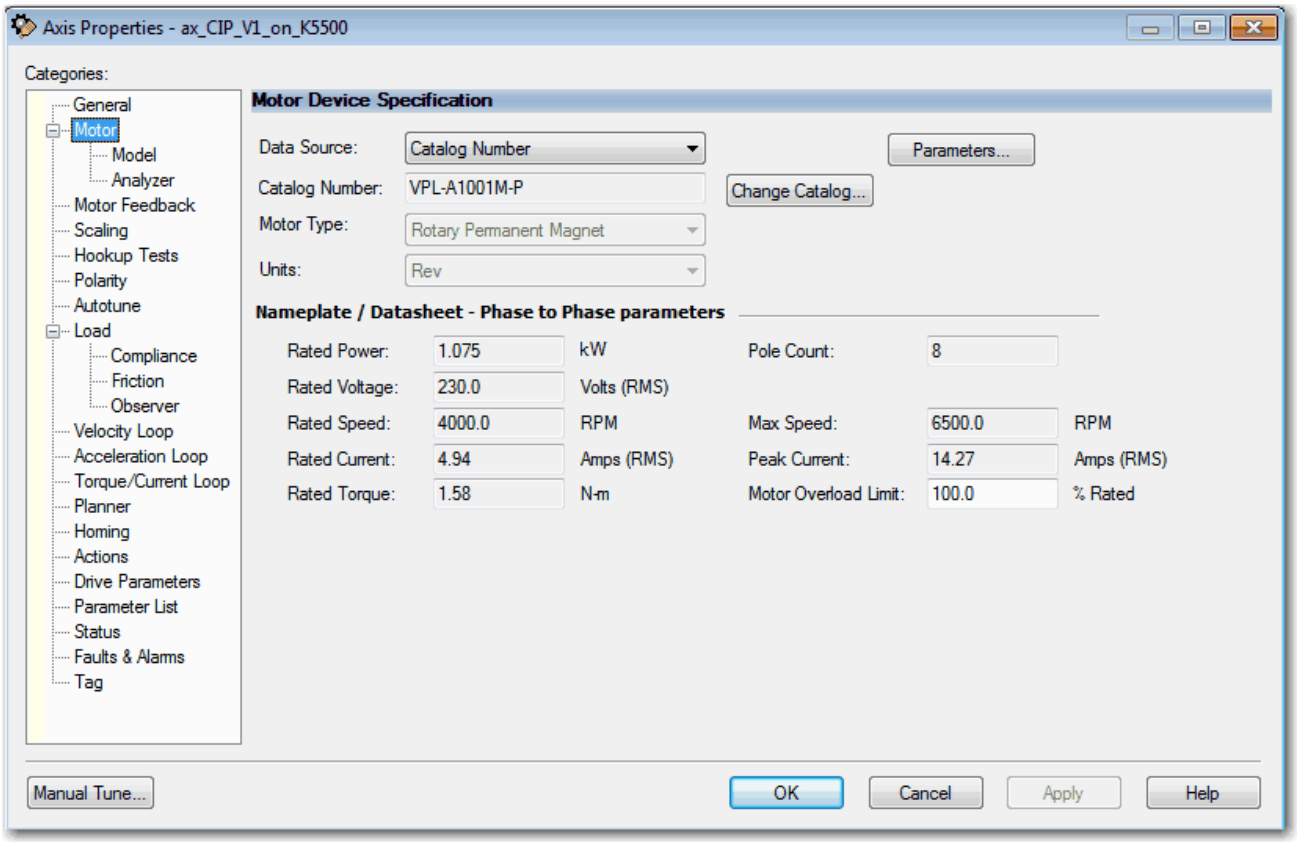


TIP After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information will be set to default values. This may cause some previously entered data to be reset back to its default setting.

Having selected Velocity Loop with Motor Feedback, the Motor and Motor Feedback dialog boxes become available.

2. Click the Motor dialog box.
3. Choose Catalog Number as the Motor Data Source.

4. Click Change Catalog and choose your motor, for example, catalog number VPL-A1001M-P.

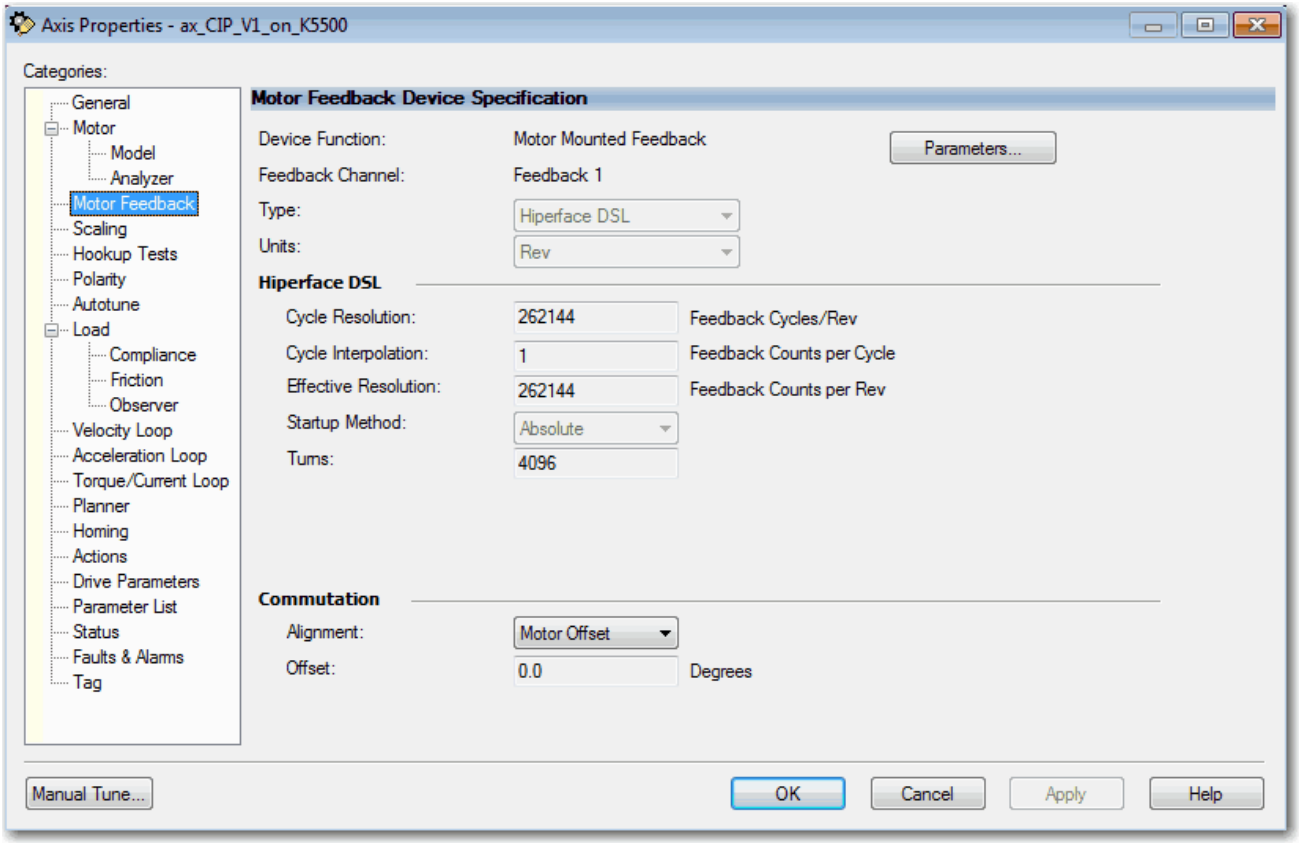


When you select the Catalog Number for the motor specification, the VPL-A1001M-P motor is in the Motion Database, The specification data for this motor is automatically filled in for you.

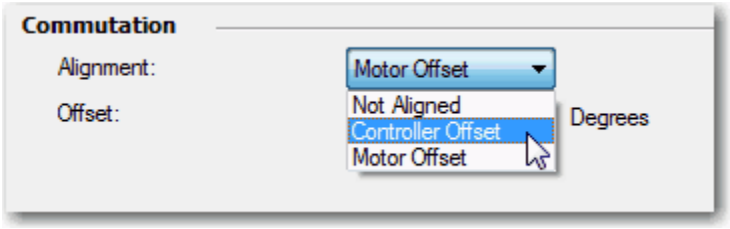
If the motor you are using is not in the Change Catalog listing, then it is not in the Motion Database. You will need to input the specification data or add a custom motor to the Motion Database that can be selected.

For more information, see Choose Nameplate on page 41.

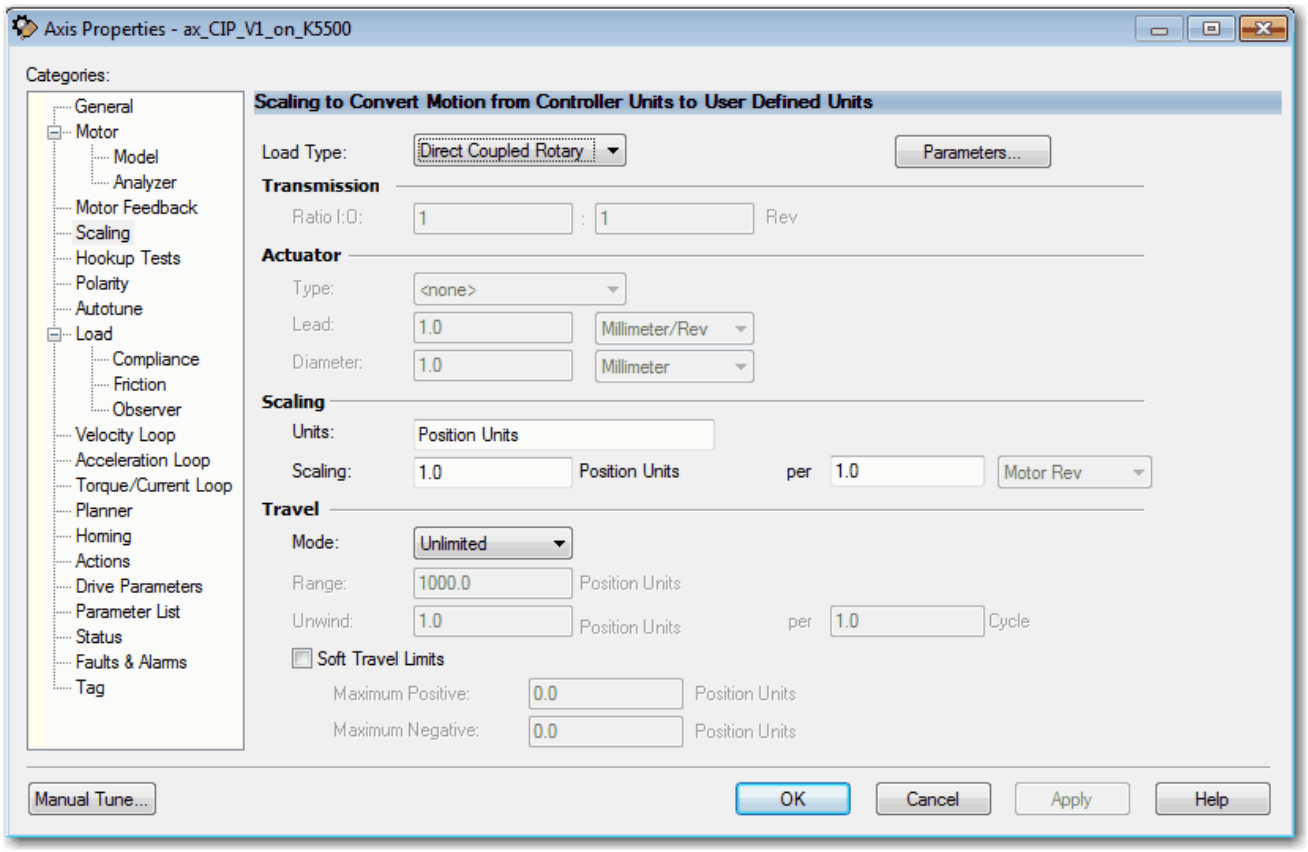
5. Click the Motor Feedback dialog box.



With this drive and motor combination, the Motor Mounted Feedback that is available is the Hiperface DSL type. The data is automatically populated based on that selection. You can assign the commutation alignment.



6. Click the Scaling dialog box to adjust the Scaling attributes.



7. Choose the Load Type
8. Enter the Scaling Units
9. .Choose the Travel Mode.

   For more information about Scaling, see Scaling Dialog Box on page 146.
10. Click Apply.

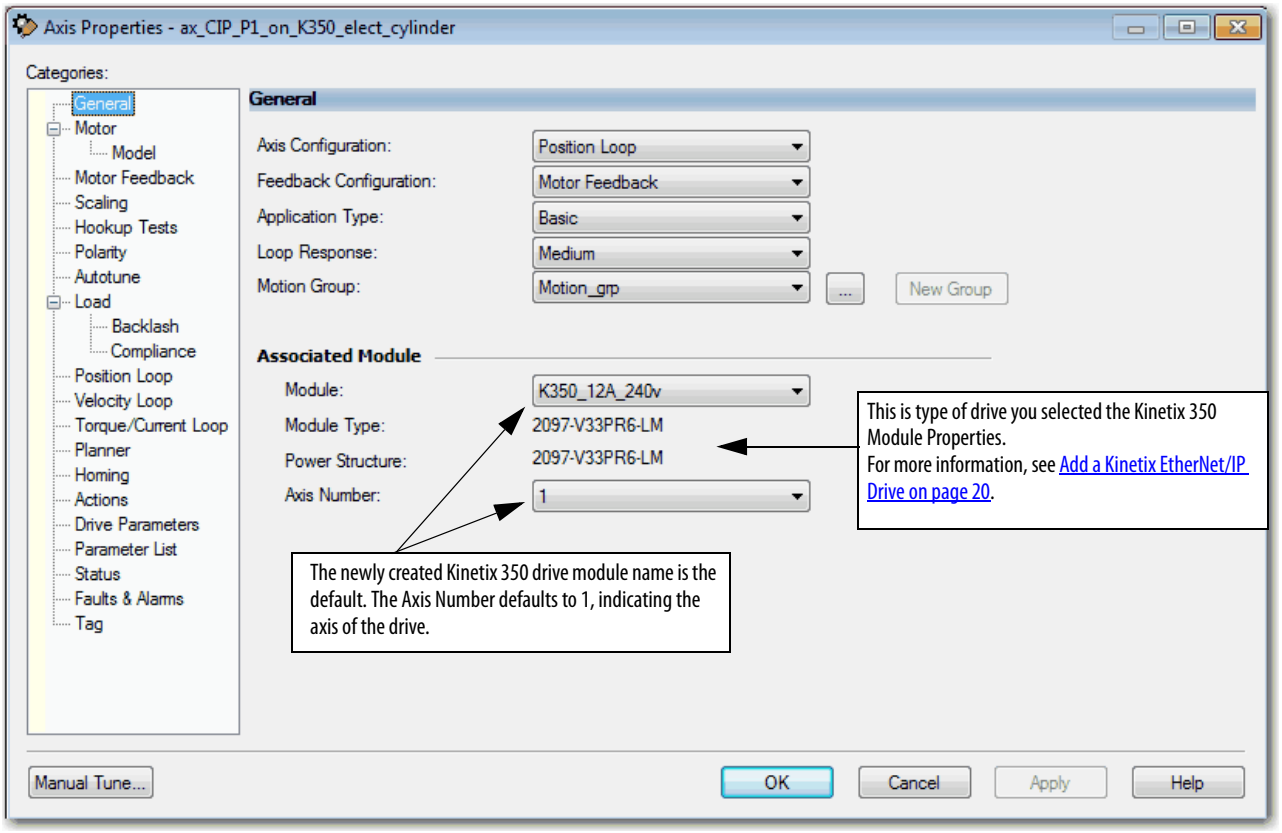
    You are now finished configuring the Kinetix 5500 axis for Velocity Loop with Motor Feedback.

Example 5: Kinetix 350 Drive, Position Loop with Motor Feedback

In this example, create a project with a CompactLogix controller, for example, 1769-L36ERM. You are configuring a Kinetix 350 drive, catalog number 2097-V33PR6-LM, with motor feedback by using a Rotary Permanent Magnet motor, catalog number MPAR-A1xxxB-V2A.

You will need to connect the Motor Feedback cable to the Motor Feedback port of the Kinetix 350 drive and then configure the feedback port.

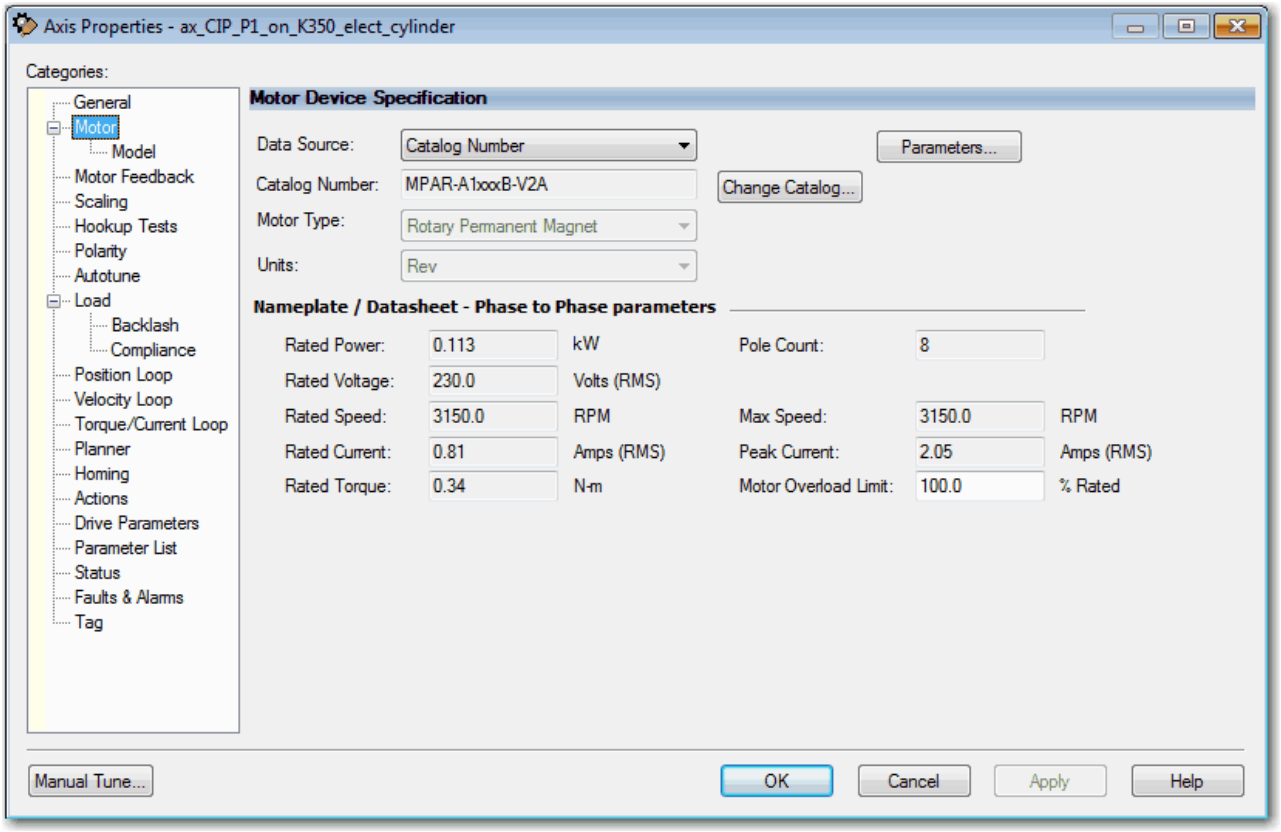
1. Once you have added the drive to your project and created an AXIS_CIP_DRIVE, open the Axis Properties.



TIP After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information will be set to default values. This may cause some previously entered data to be reset back to its default setting.

2. Click the Motor dialog box.
3. Choose Catalog Number as the Motor Data Source.

4. Click Change Catalog and choose your motor, for example, catalog number MPAR-A1xxxB-V2A.

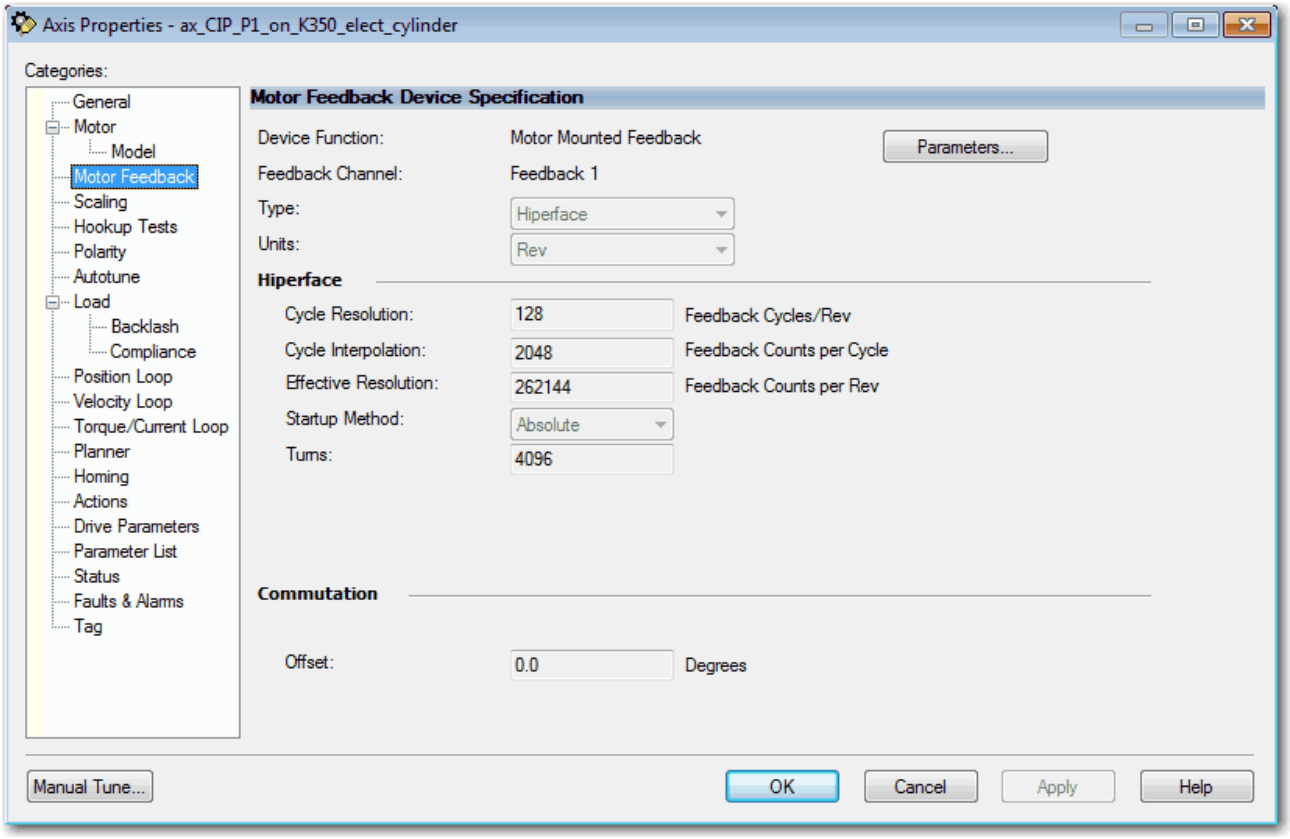


When you select the Catalog Number for the motor specification, the MPAR-A1xxxB-V2A motor is in the Motion Database, The specification data for this motor is automatically filled in for you.

If the motor you are using is not in the Change Catalog listing, then it is not in the Motion Database. You will need to input the specification data or add a custom motor to the Motion Database that can be selected.

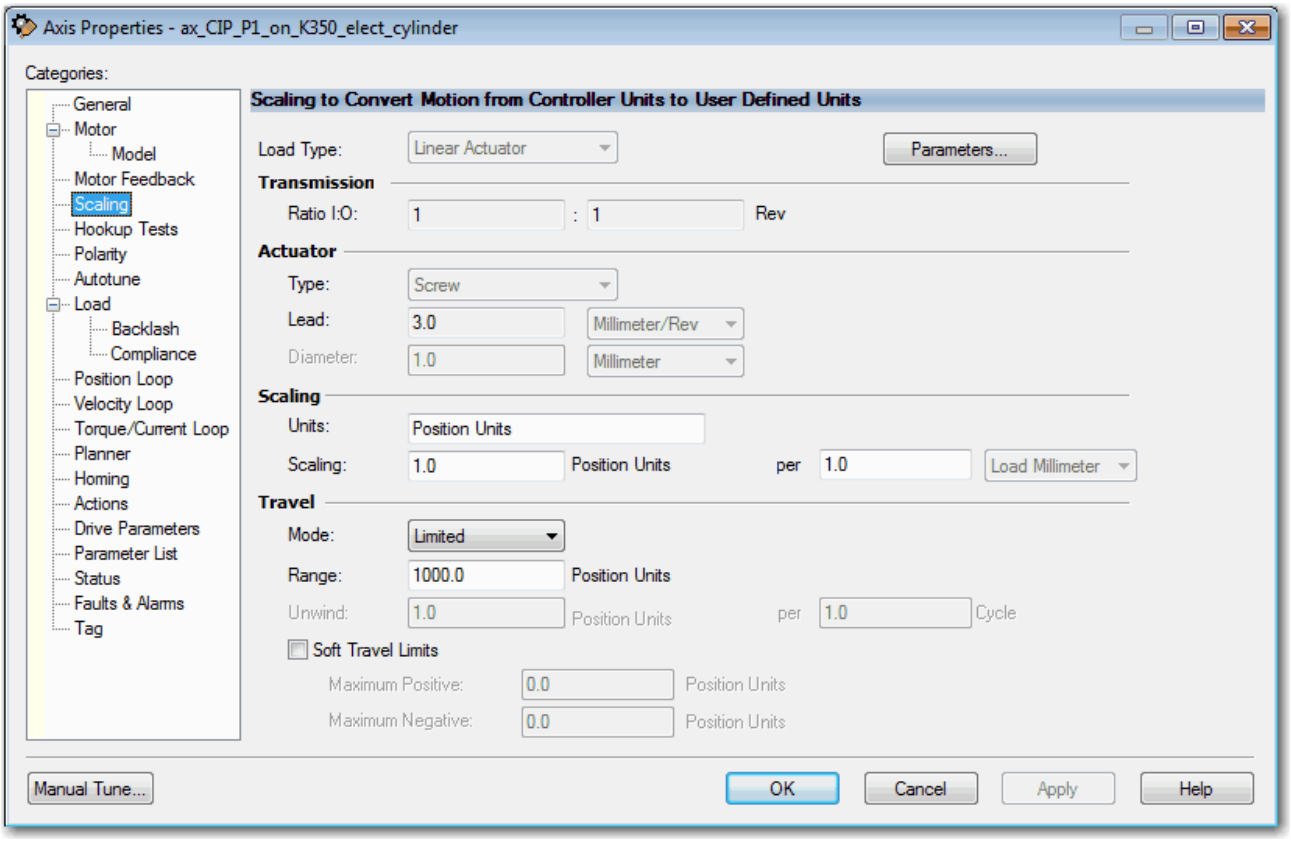
For more information, see Choose Nameplate on page 41.

5. Click the Motor Feedback dialog box.



With this drive and motor combination, the data is automatically populated based on that selection.

6. Click the Scaling dialog box to adjust the Scaling attributes.



The default load type is linear actuator.

7. Enter the Scaling Units.
8. Enter the Travel Range.

   For more information about Scaling, see Scaling Dialog Box on page 146.

9. Click OK.

   You are now finished configuring the Kinetix 350 axis for Position Loop with Motor Feedback.

Notes:

Axis Configuration Examples for the PowerFlex 755 Drive

This chapter provides example axis configurations when using a PowerFlex 755 drive.

Topic	Page
Example 1: Position Loop with Motor Feedback Using a UFB Feedback Device	122
Example 2: Position Loop with Dual Motor Feedback Via a UFB Feedback Device	125
Example 3: Velocity Loop with Motor Feedback Via a UFB Feedback Device	130
Example 4: Velocity Loop with No Feedback	134
Example 5: Frequency Control with No Feedback	137
Example 6: Torque Loop with Feedback	141

The following six examples are typical axis configuration applications for the PowerFlex 755 drive:

- Position Loop with Motor Feedback
- Position Loop with Dual Feedback
- Velocity Loop with Motor Feedback
- Velocity Control with No Feedback
- Frequency Control with No Feedback
- Torque Loop with Feedback

Example 1: Position Loop with Motor Feedback Using a UFB Feedback Device

This example describes how to create an AXIS_CIP_DRIVE axis that is associated to a PowerFlex 755 drive with motor feedback via a universal feedback device, catalog number 20-750-UFB-1.

TIP Remember that you already assigned the feedback device when you added the drive to your project.

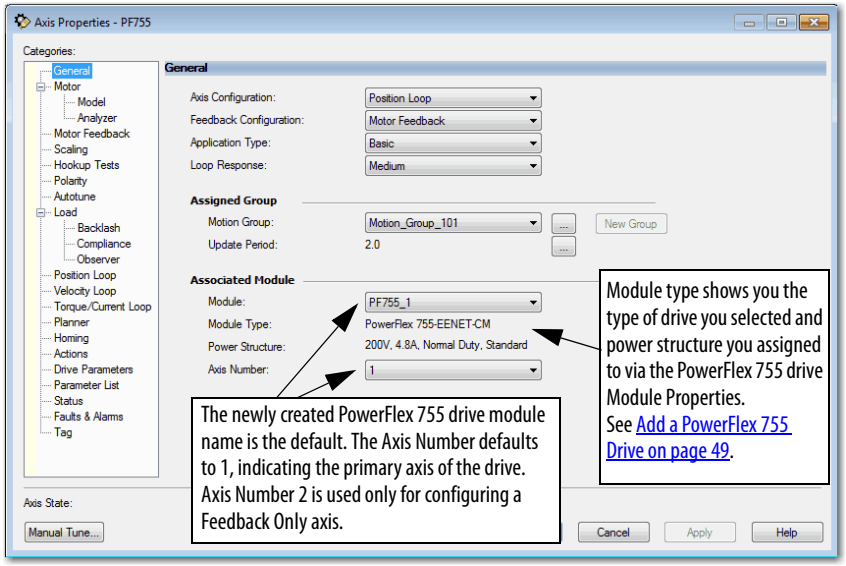
See Create an Axis for a PowerFlex 755 Drive on page 54 for more information about feedback devices.

1. Once you have created an AXIS_CIP_DRIVE, open the Axis Properties.
2. From the Axis Configuration pull-down menu, choose Position Loop.

   When you choose the configuration type, it determines the Control Mode.

   See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003.

Example 1: Position Loop with Motor Feedback, General Dialog Box

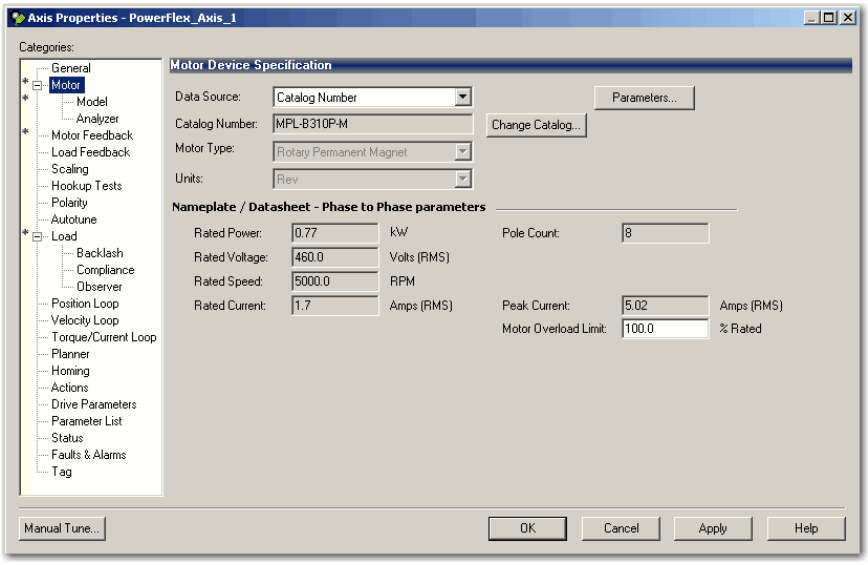


3. From the Feedback Configuration pull-down menu, choose Motor Feedback.

TIP After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information is set to default values. This can cause some previously entered data to be reset back to its default setting.

Now that you defined the axis as being a Position Loop with Motor Feedback, the Motor and Motor Feedback dialog boxes become available.

Example 1: Position Loop with Motor Feedback, Motor Dialog Box

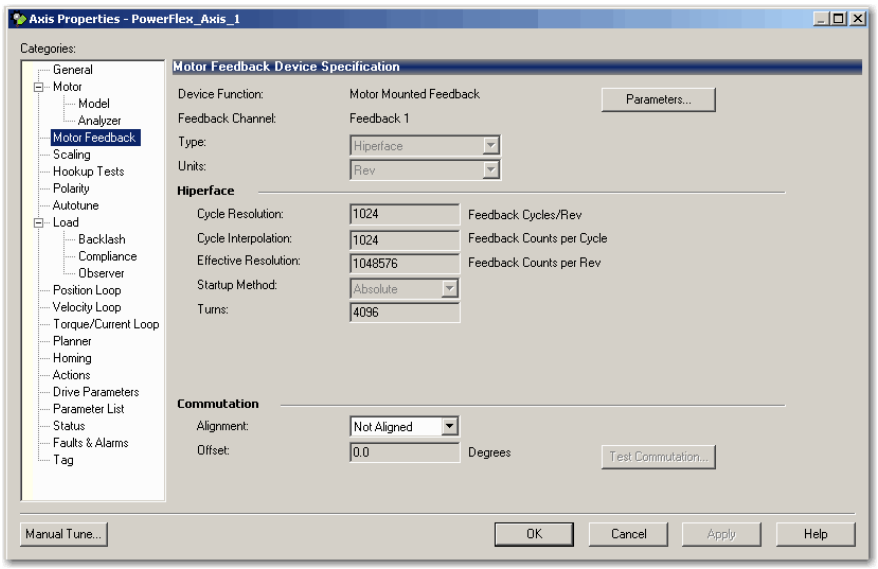


4. Choose Catalog Number as the Data Source.
5. Click Change Catalog and choose a motor.

   When you select the Catalog Number for the motor specification, the MPL-B310P-M motor is in the Motion Database. The specification data for this motor is automatically entered for you. If the motor you are using is not in the Change Catalog list, then it is not in the Motion Database. You have to enter the specification data on your own.

   The Motor Feedback dialog box is automatically filled based on your motor selection.

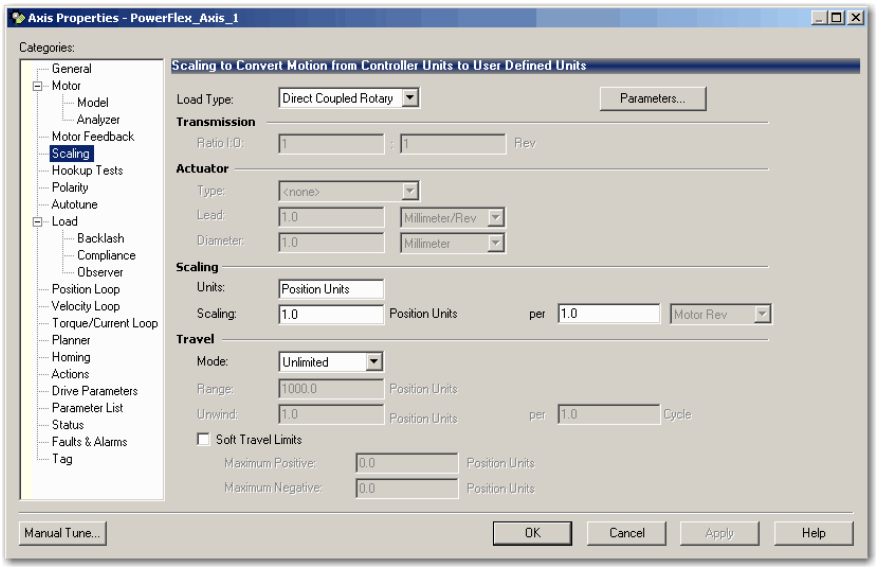
Example 1: Position Loop with Motor Feedback, Motor Feedback Dialog Box



6. Choose the Commutation Alignment.

For more information about Commutation, see Assign Motor Feedback on page 43 and Commutation Test on page 156.

Example 1: Position Loop with Motor Feedback, Scaling Dialog Box



7. From the Load Type pull-down menu, choose your type of load.
8. Enter the Scaling Units.
9. From the Travel Mode pull-down menu, choose your Travel Mode.

   For more information about Scaling, see Scaling Dialog Box on page 146.
10. Click Apply and OK to exit Axis Properties.

The axis is now configured for Position Loop with Motor Feedback.

Example 2: Position Loop with Dual Motor Feedback Via a UFB Feedback Device

This example describes how to create an AXIS_CIP_DRIVE axis that is associated to a PowerFlex 755 drive with dual motor feedback via a universal feedback device, catalog number 20-750-UFB-1.

TIP Remember that you already assigned the feedback device when you added the drive to your project.

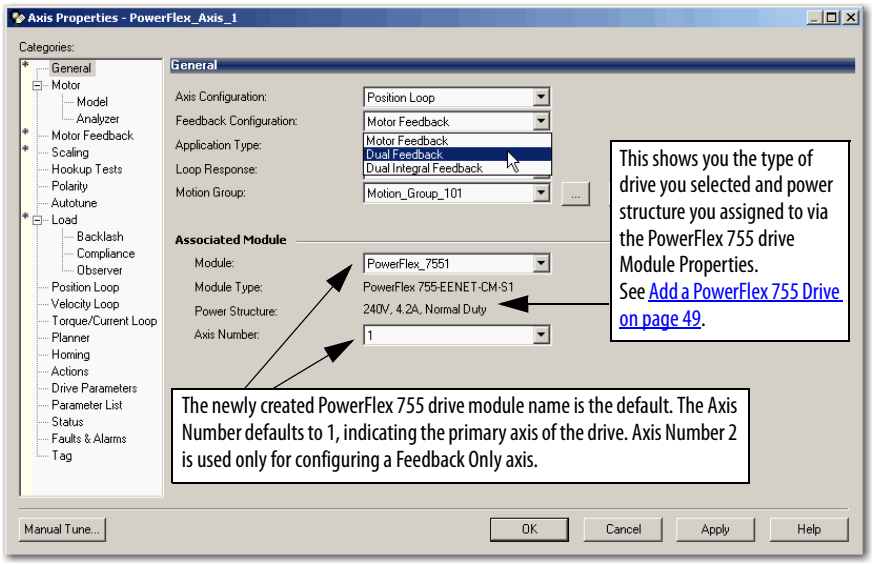
See Create an Axis for a PowerFlex 755 Drive on page 54 for more information about feedback devices.

1. Once you have created an AXIS_CIP_DRIVE, open the Axis Properties.
2. From the Axis Configuration pull-down menu, choose Position Loop.
3. From the Feedback Configuration pull-down menu, choose Dual Feedback.

   When you choose the configuration type, it determines the Control Mode.

   See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003.

Example 2: Position Loop with Dual Feedback, General Dialog Box

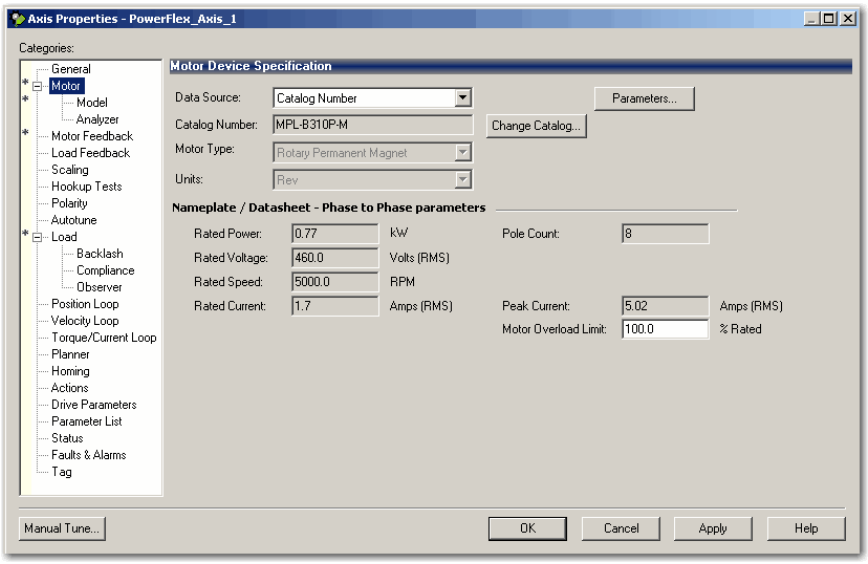


IMPORTANT After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information is set to default values. This can cause some previously entered data to be reset back to its default setting.

Now that you defined the axis as being a Position Loop with Dual Feedback axis, the Motor Feedback, and Load Feedback dialog boxes become available.

4. From the Data Source pull-down menu, choose Catalog Number.

Example 2: Position Loop with Dual Feedback, Motor Dialog Box



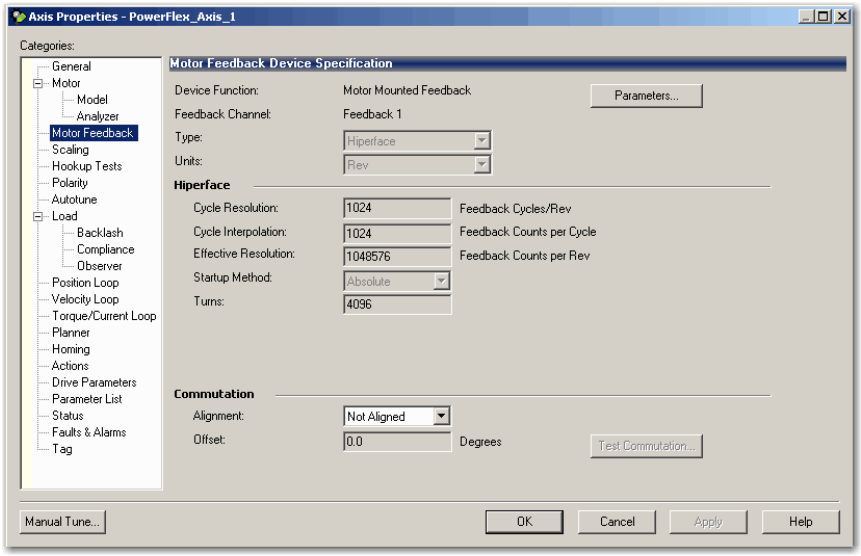
5. Click Change Catalog and choose your motor.

   In this case, a MPL-B310P-M motor was chosen.

   When you select the Catalog Number for the motor specification, the MPL-B310P-M motor is in the Motion Database. The specification data for this motor is automatically entered for you. If the motor you are using is not listed in Change Catalog, then it is not in the Motion Database. You have to enter the specification data on your own.

   The Motor Feedback dialog box is automatically filled based on your motor selection.

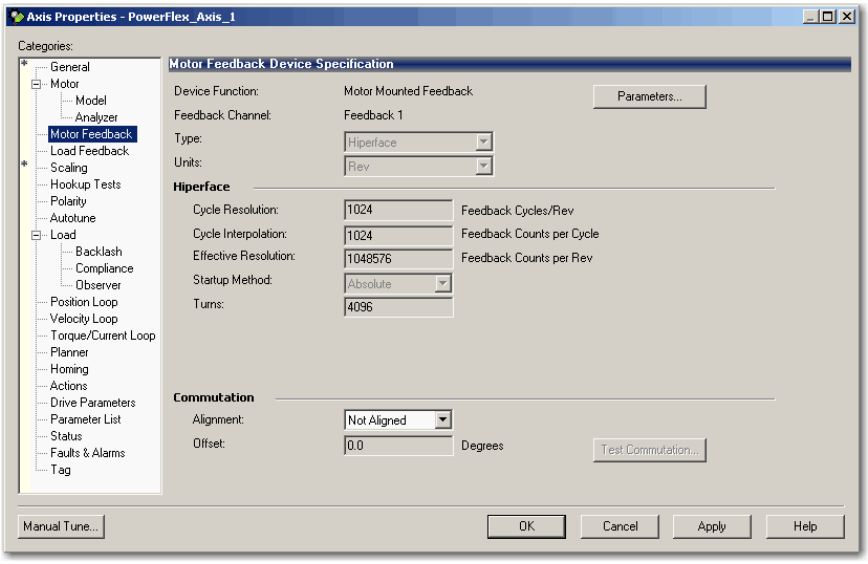
Example 2: Position Loop with Dual Feedback, Motor Feedback Dialog Box



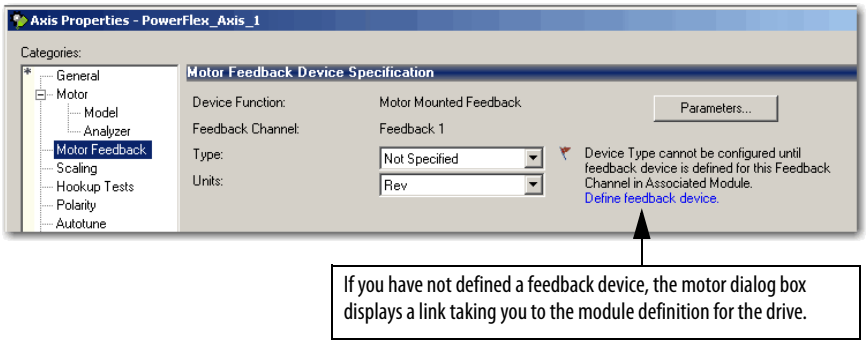
6. Choose the Commutation Alignment.

For more information about Commutation, see Commutation Test on page 156.

Example 2: Position Loop with Dual Feedback, Motor Feedback Dialog Box



On the Motor Feedback dialog box, the information is automatic based on your selections on the Motor dialog box.

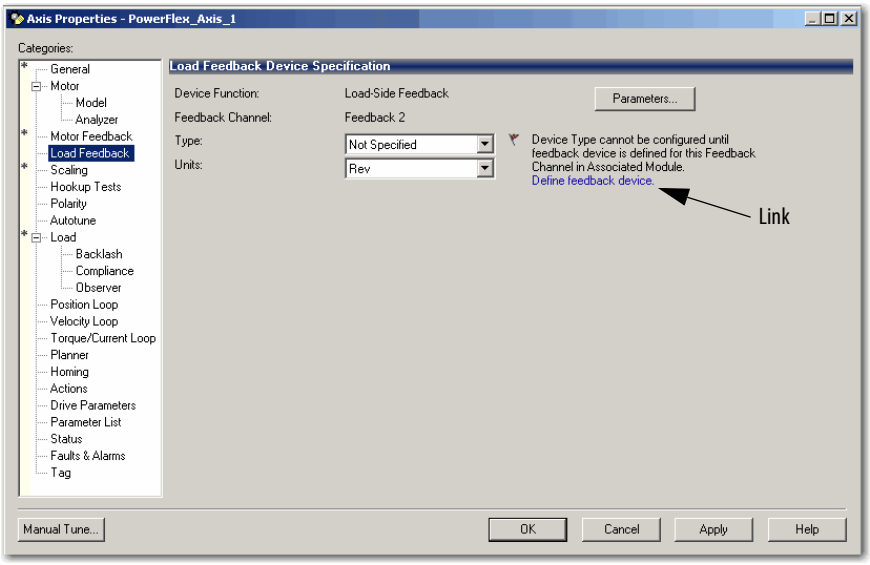

Axis Properties - PowerFlex_Axis_1
Categories:
General
Motor
Model
Analyzer
Motor Feedback
Scaling
Hookup Tests
Polarity
Autotune
Motor Feedback Device Specification
Device Function: Motor Mounted Feedback
Parameters...
Feedback Channel: Feedback 1
Type: Not Specified
Units: Rev
Device Type cannot be configured until feedback device is defined for this Feedback Channel in Associated Module.
Define feedback device.
If you have not defined a feedback device, the motor dialog box displays a link taking you to the module definition for the drive.

The axis is now configured as a Position Loop with two feedback devices. The next task is to configure Feedback 2 on the Load Feedback dialog box.

Follow these instructions to define the Load feedback.

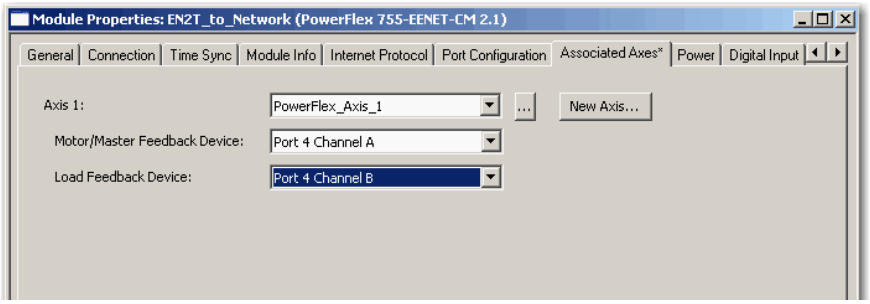
1. From the Load Feedback dialog box, click the Define feedback device link.

Example 2: Load-side Feedback, Load Feedback Dialog Box



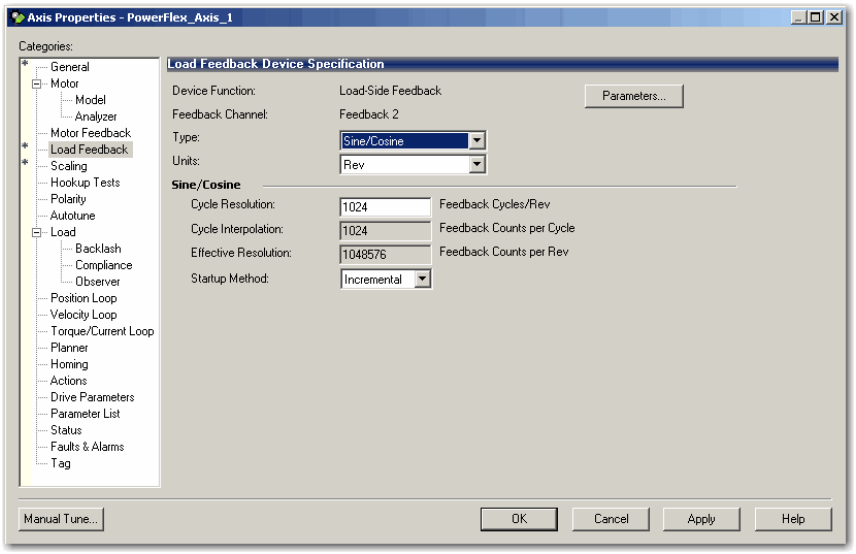
2. Click Associated Axes in Module Properties dialog box.
3. From the Load Feedback Device pull-down menu, choose the appropriate port/channel for the Load Feedback Device.

Example 2: PowerFlex 755 Module Properties, Associated Axis Tab

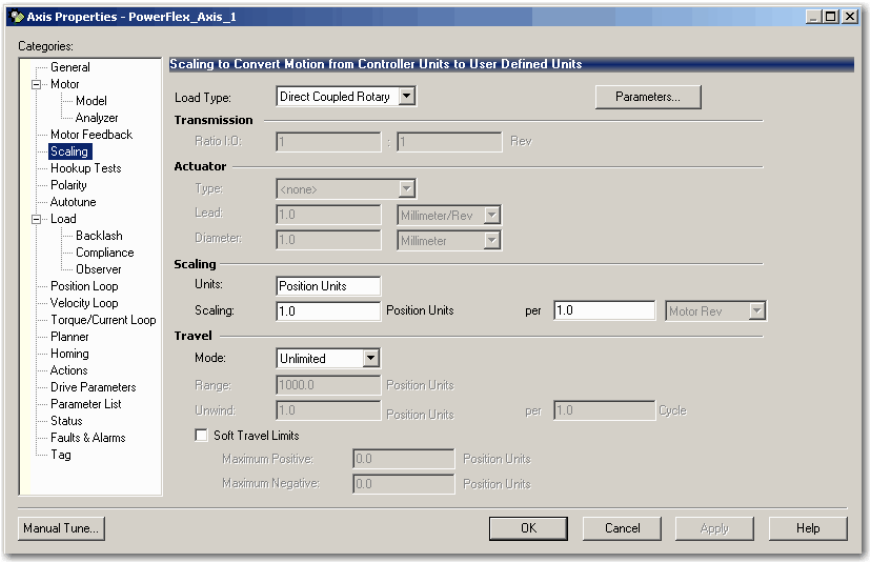


4. From the Type pull-down menu, choose the type of feedback.
5. From the Units pull-down menu, choose the appropriate units.
6. Click Apply.

Example 2: Load-side Feedback, Load Feedback Dialog Box



Example 2: Position Loop with Dual Feedback, Scaling Dialog Box



7. From the Load Type pull-down menu, choose your load type.
8. Enter the Scaling Units.
9. From the Travel Mode pull-down menu, choose a Travel Mode.

   See Scaling Dialog Box on page 146 for more information about Scaling.
10. Click Apply and OK to exit Axis Properties.

You are now finished configuring a PowerFlex 755 drive axis as Position Loop with Dual Feedback.

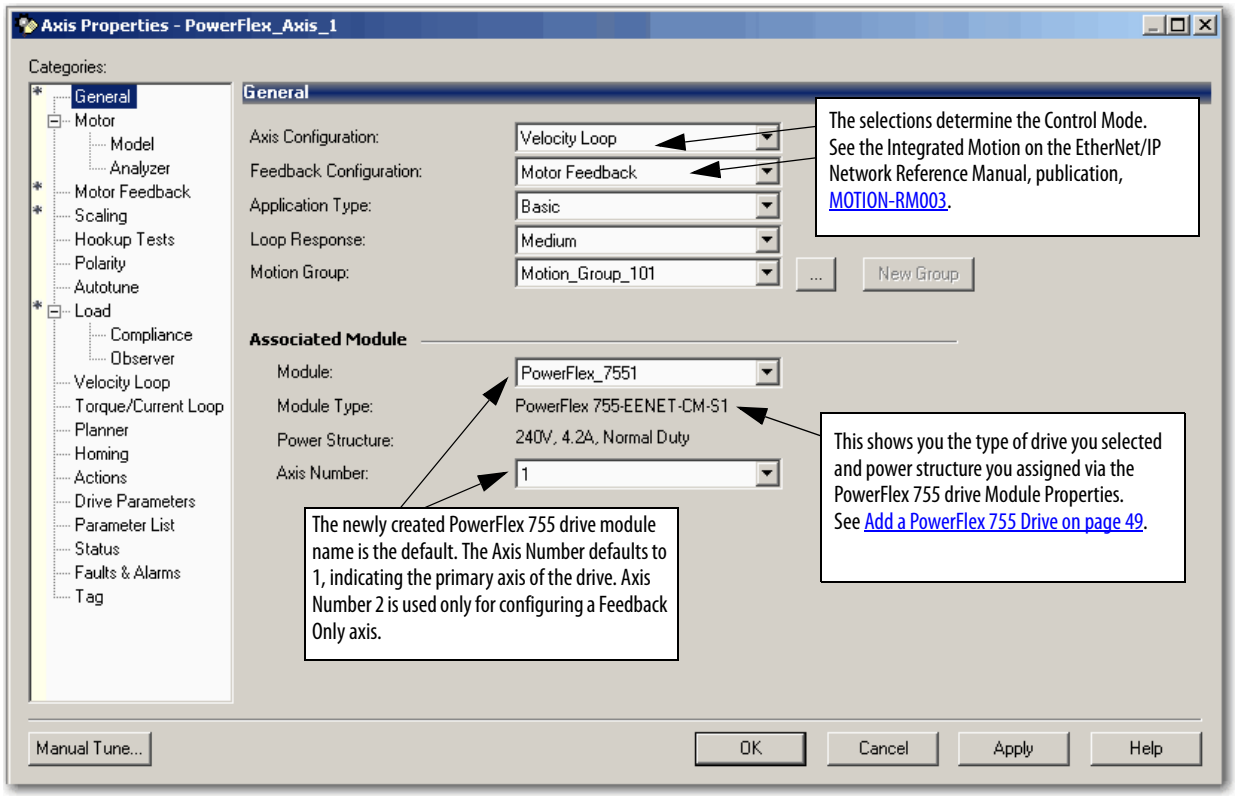
Example 3: Velocity Loop with Motor Feedback Via a UFB Feedback Device

This example describes how to create two AXIS_CIP_DRIVE axes that are associated to a PowerFlex 755 drive with dual motor feedback via a universal feedback device, catalog number 20-750-UFB-1.

TIP Remember that you already assigned the feedback device when you added the drive to your project.

1. Once you have created an AXIS_CIP_DRIVE, open the Axis Properties.
2. Connect the Feedback Port 1 with one feedback cable that is connected to the PowerFlex 755 drive.
3. From the Axis Configuration pull-down menu, choose Velocity Loop.
4. From the Feedback Configuration pull-down menu, choose Motor Feedback.

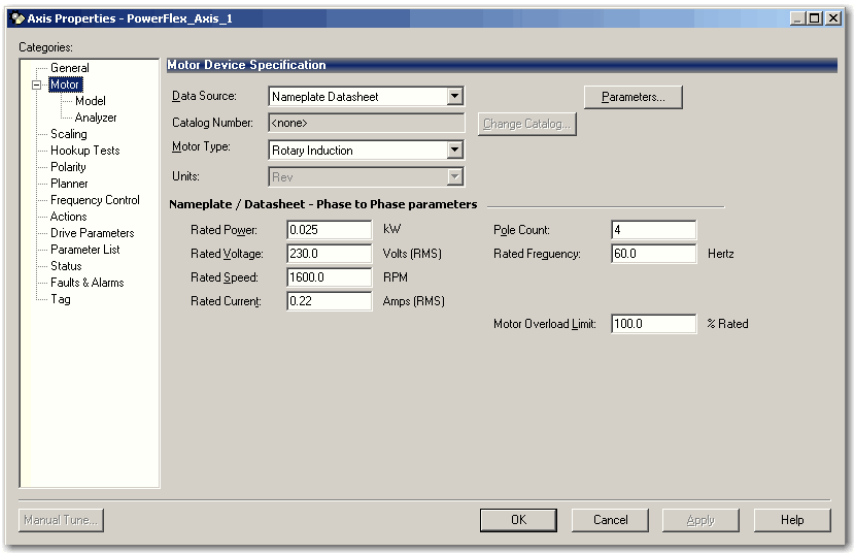
Example 3: Velocity Loop with Motor Feedback, General Dialog Box



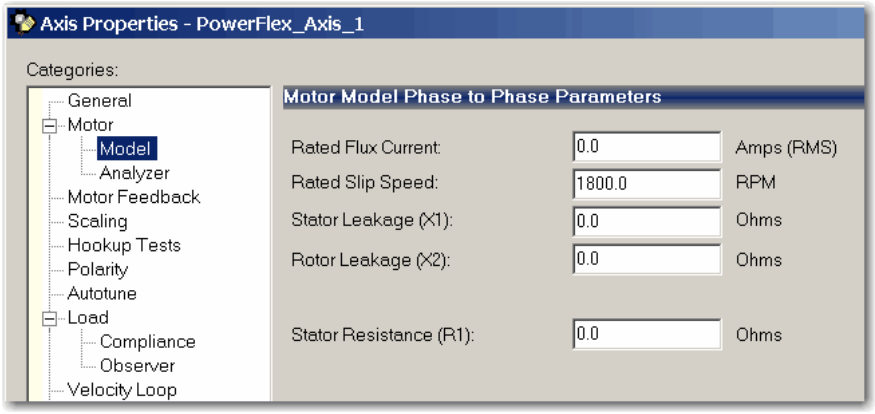
IMPORTANT After you have configured the axis and you change the Axis Configuration type or the Axis Number, some of the configuration information is set to default values. This can cause some previously entered data to be reset back to its default setting.

Now that you defined the axis as a Velocity Loop with Motor Feedback, the Motor and Motor Feedback dialog boxes become available.

Example 3: Velocity Loop with Motor Feedback, Motor Dialog Box

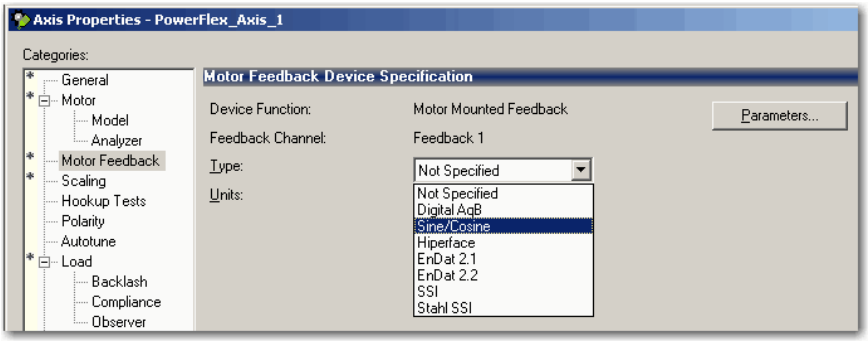


5. From the Data Source pull-down menu, choose Nameplate Datasheet.
6. From the Motor Type pull-down menu, choose Rotary Induction.
7. Enter the parameters by using the information from the motor Nameplate or Datasheet and click Apply.



8. Enter the parameters on the Motor Model dialog box by using the information from the motor Nameplate or Datasheet and click Apply.

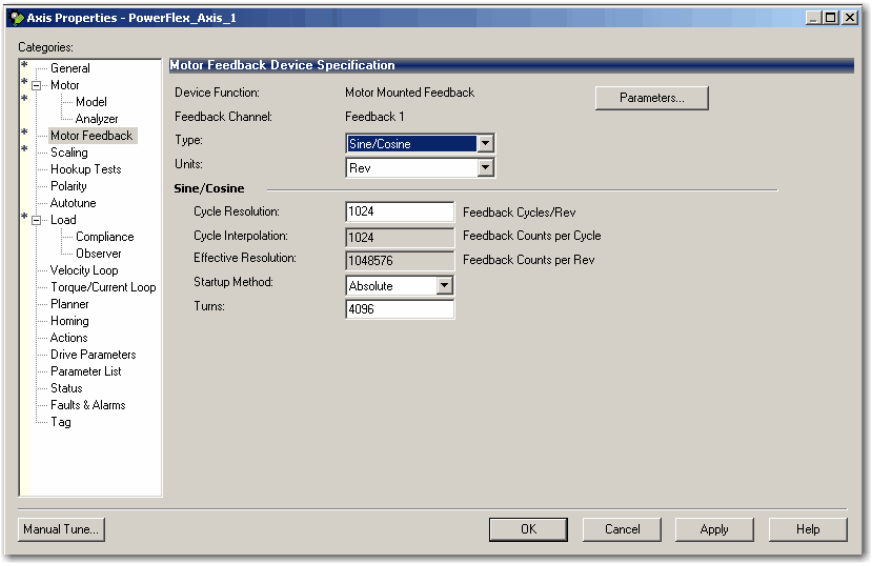
Example 3: Motor Feedback Dialog Box, Velocity Loop with Motor Feedback



9. From the Type pull-down menu, choose the type of feedback.

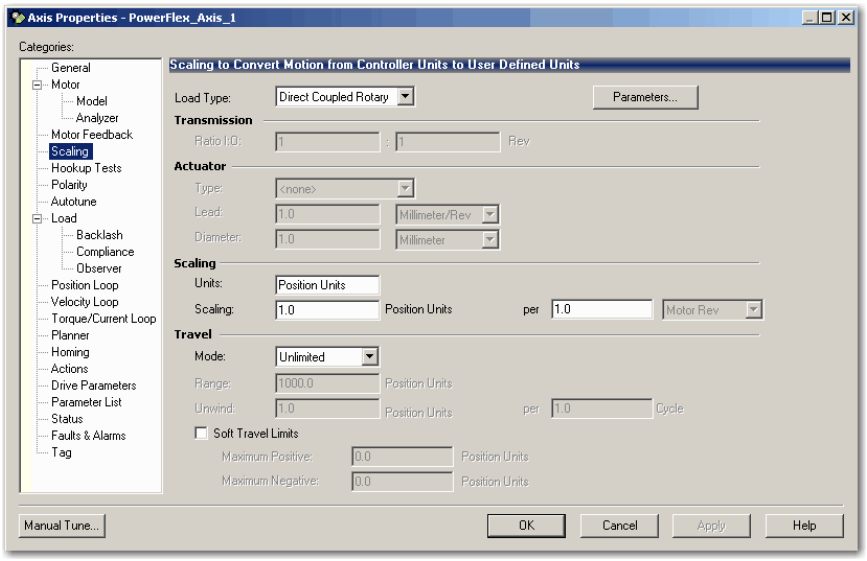
   The fields are populated with the data that relates to the motor and feedback types you chose.

Example 3: Velocity Loop with Motor Feedback, Motor Feedback Dialog Box



10. Click Scaling.

Example 3: Velocity Loop with Motor Feedback, Scaling Dialog Box



11. From the Load Type pull-down menu, choose the appropriate load type.
12. Enter the Scaling Units.
13. From the Travel Mode pull-down menu, choose the appropriate Travel Mode.

    See Scaling Dialog Box on page 146 for more information.

14. Click Apply and OK to exit Axis Properties.

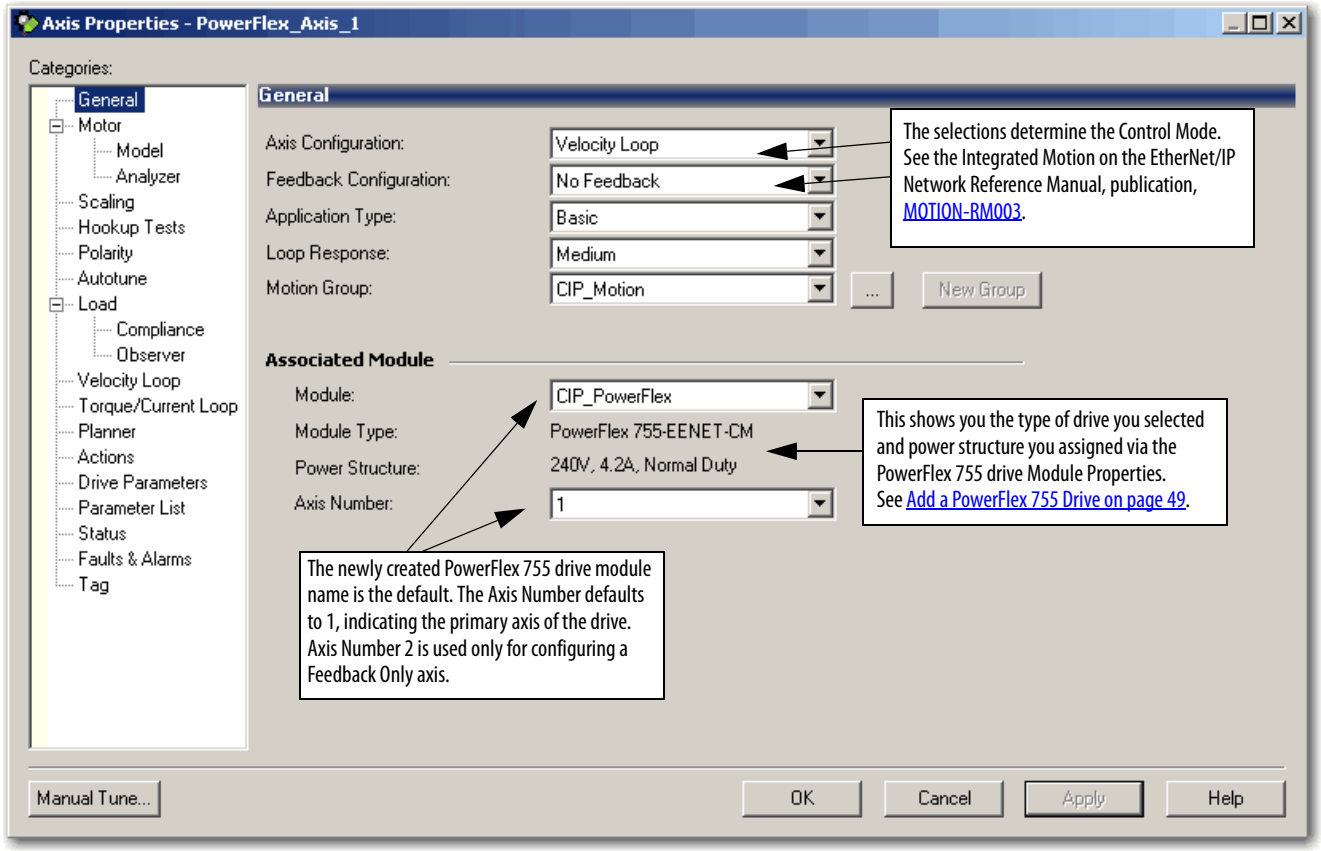
You are now finished configuring the axis as Velocity Loop with Motor Feedback.

Example 4: Velocity Loop with No Feedback

In this example, you create an AXIS_CIP_DRIVE configured for a Velocity Loop with No Feedback axis and associate the axis to the PowerFlex 755 drive.

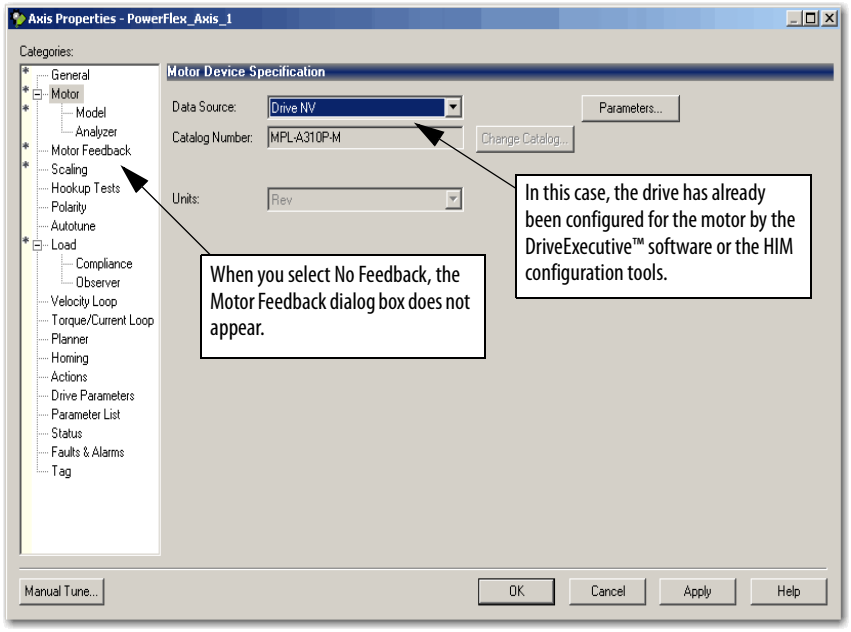
1. From the Axis Configuration pull-down menu, choose Velocity Loop.
2. From the Feedback Configuration pull-down menu, choose No Feedback.

Example 4: Velocity Loop with No Feedback, General Dialog Box

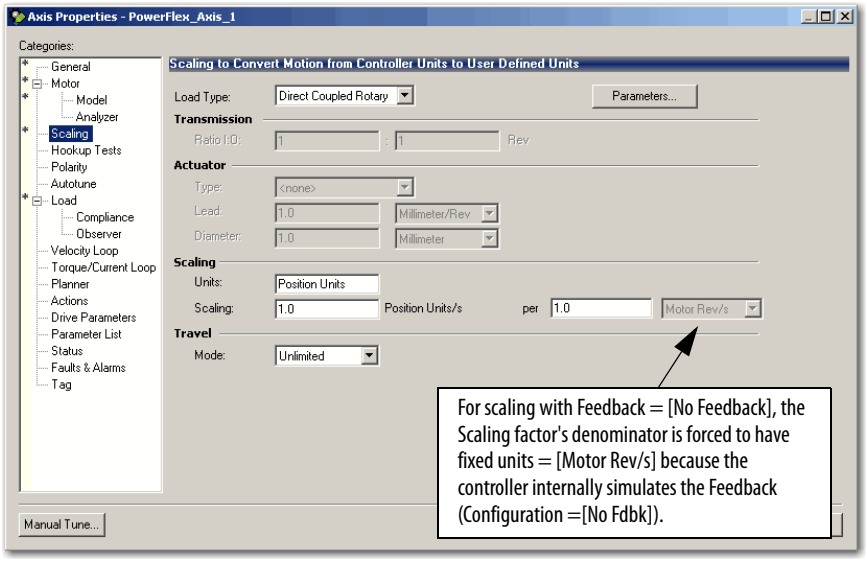


3. From the Data Source pull-down menu, choose Nameplate Datasheet.

Example 4: Velocity Loop with No Feedback, Motor Dialog Box



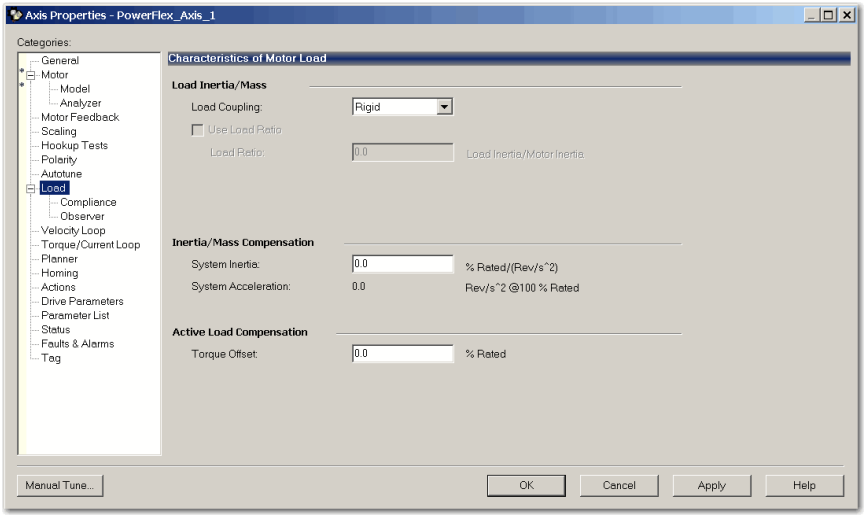
Example 4: Velocity Loop with No Feedback, Scaling Dialog Box



4. From the Load Type pull-down menu, choose the appropriate load type.
5. Enter the Scaling Units.
6. From the Travel Mode pull-down menu, choose the appropriate Travel Mode.

   See Scaling Dialog Box on page 146 for more information.
7. Click Apply.

Example 4: Velocity Loop with No Feedback, Load Dialog Box



8. From the Load Coupling pull-down menu, choose the appropriate load coupling.
9. Enter the System Inertia.
10. Enter the Torque Offset, if applicable.

    For more information about the load characteristics, see Load Dialog Box on page 164.
11. Click Apply.

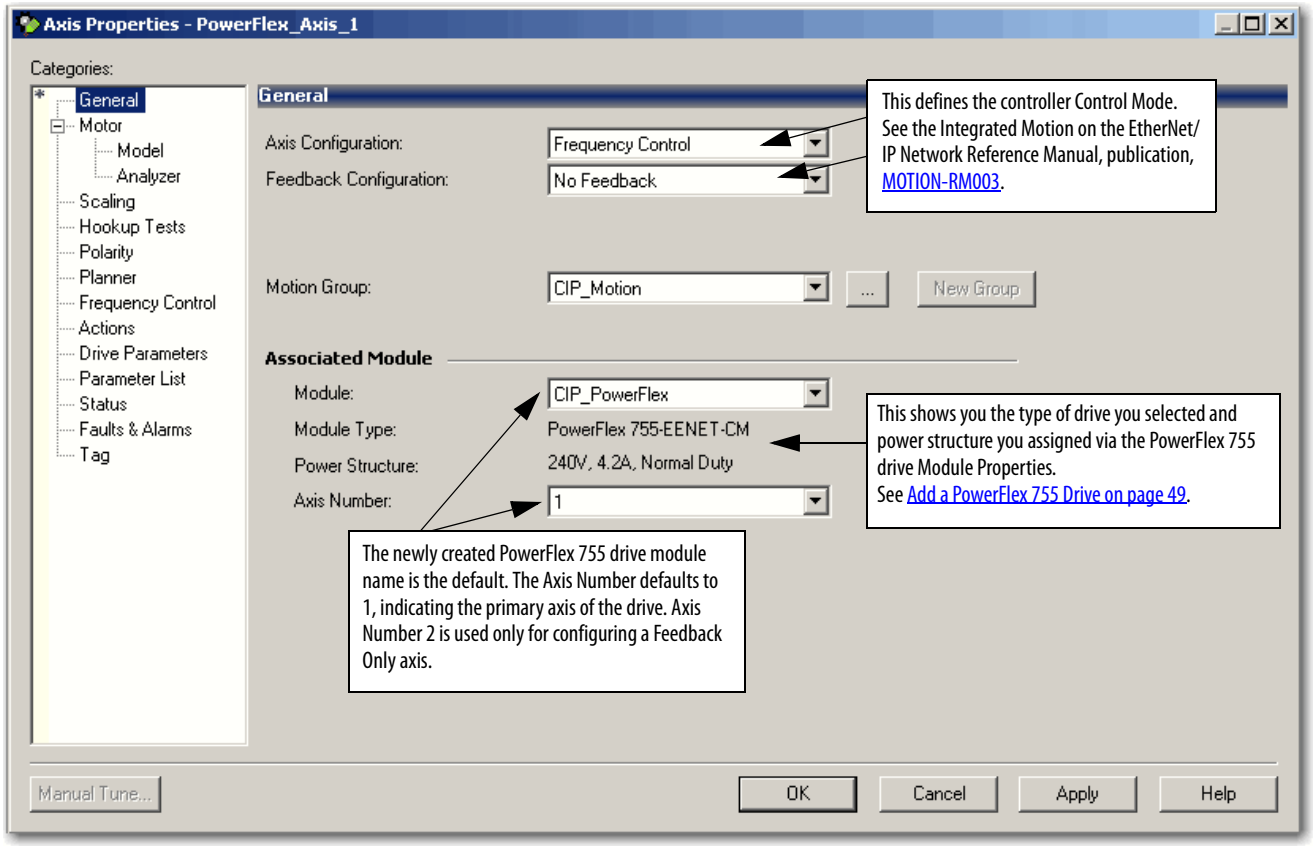
You are now finished configuring an axis as Velocity Loop with No Feedback.

Example 5: Frequency Control with No Feedback

In this example, you are configuring an axis for Frequency Control with No Feedback.

1. Once you have created the AXIS_CIP_DRIVE axis, open the Axis Properties.
2. From the Axis Configuration pull-down menu, choose Frequency Control.
3. From the Feedback Configuration pull-down menu, choose No Feedback.

Example 5: Frequency Control with No Feedback, General Dialog Box

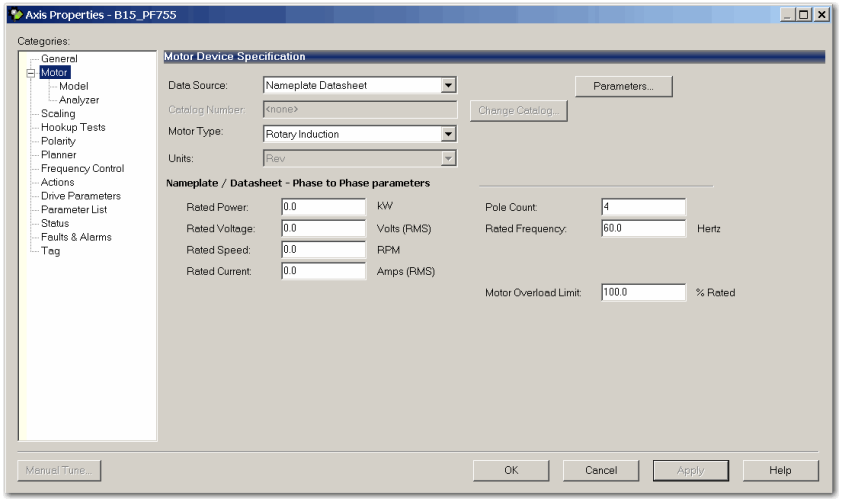


4. From the Data Source pull-down menu, choose a data source.

   In this case, Nameplate Datasheet is the Data Source.

   See the Specifying the Motor Data Source on page 39 for more information about Data Sources.

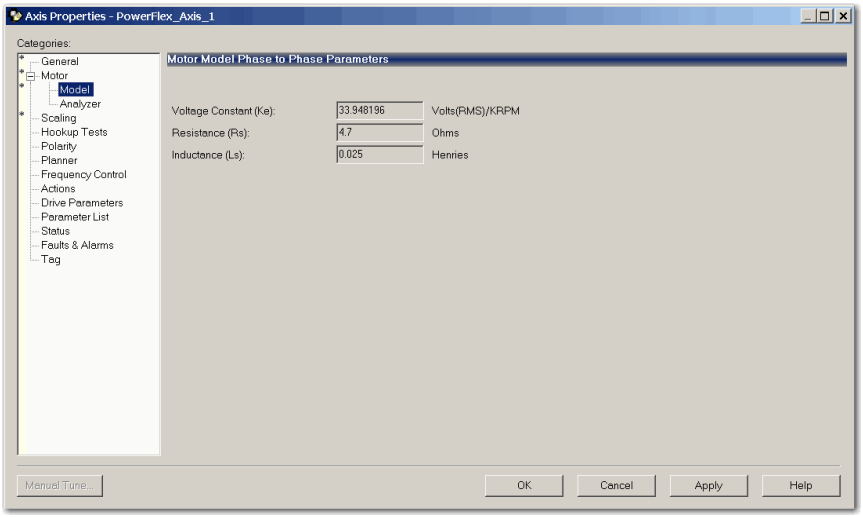
Example 5: Frequency Control with No Feedback, Motor Dialog Box



In this case, the data source is Catalog Number and the Motion Database provides values for these fields.

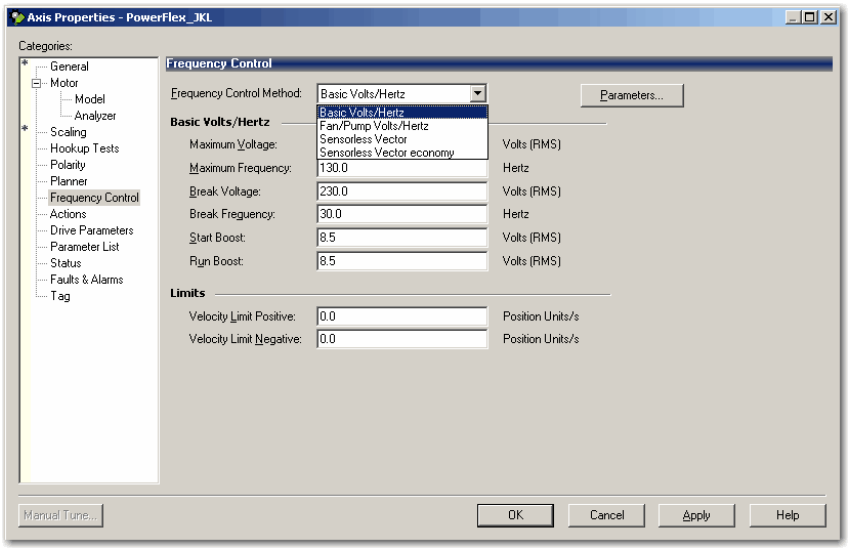
See the Display Motor Model Information on page 42 for more information about data sources.

Example 5: Frequency Control with No Feedback, Motor Model Dialog Box

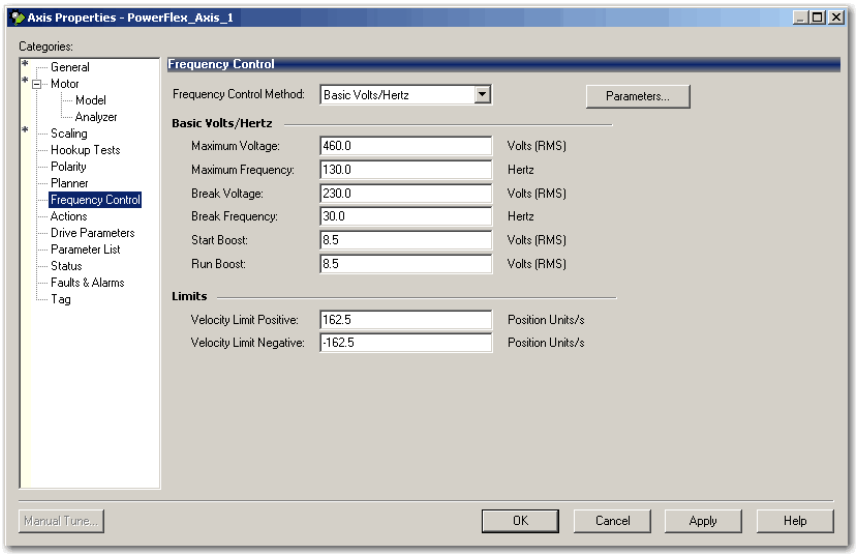


5. From the Frequency Control Method pull-down menu, choose the appropriate method.
6. Click Apply.

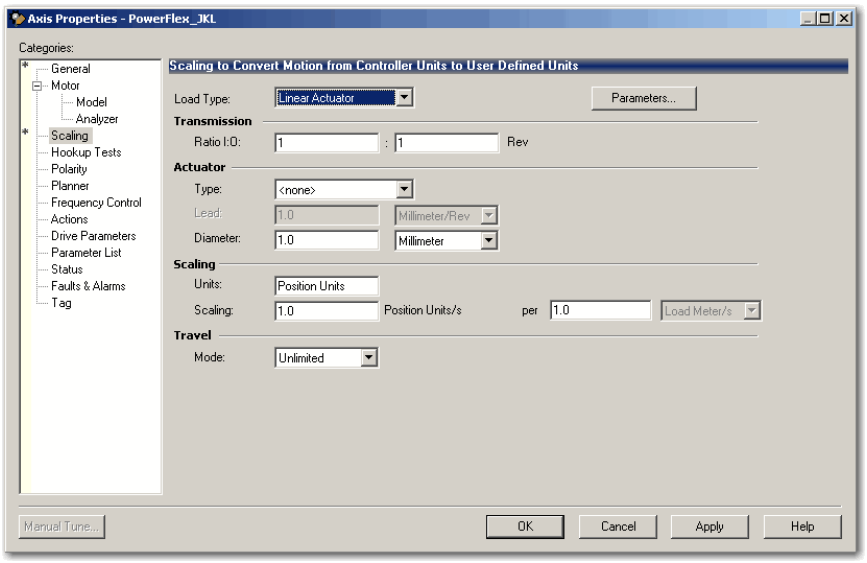
Example 5: Frequency Control with No Feedback, Frequency Control Dialog Box



Example 5: Frequency Control Method, Basic Volts/Hertz



Example 5: Frequency Control with No Feedback, Scaling Dialog Box Conversion Units



7. From the Load Type pull-down menu, choose the appropriate load type.
8. Enter the Transmission Ratio.
9. From the Actuator Type pull-down menu, choose the appropriate actuator.
10. Enter the Diameter dimensions.
11. Enter the Scaling Units.

    See the Scaling Dialog Box on page 146 for more information.
12. From the Travel Mode pull-down menu, choose the appropriate travel mode.
13. Click Apply.

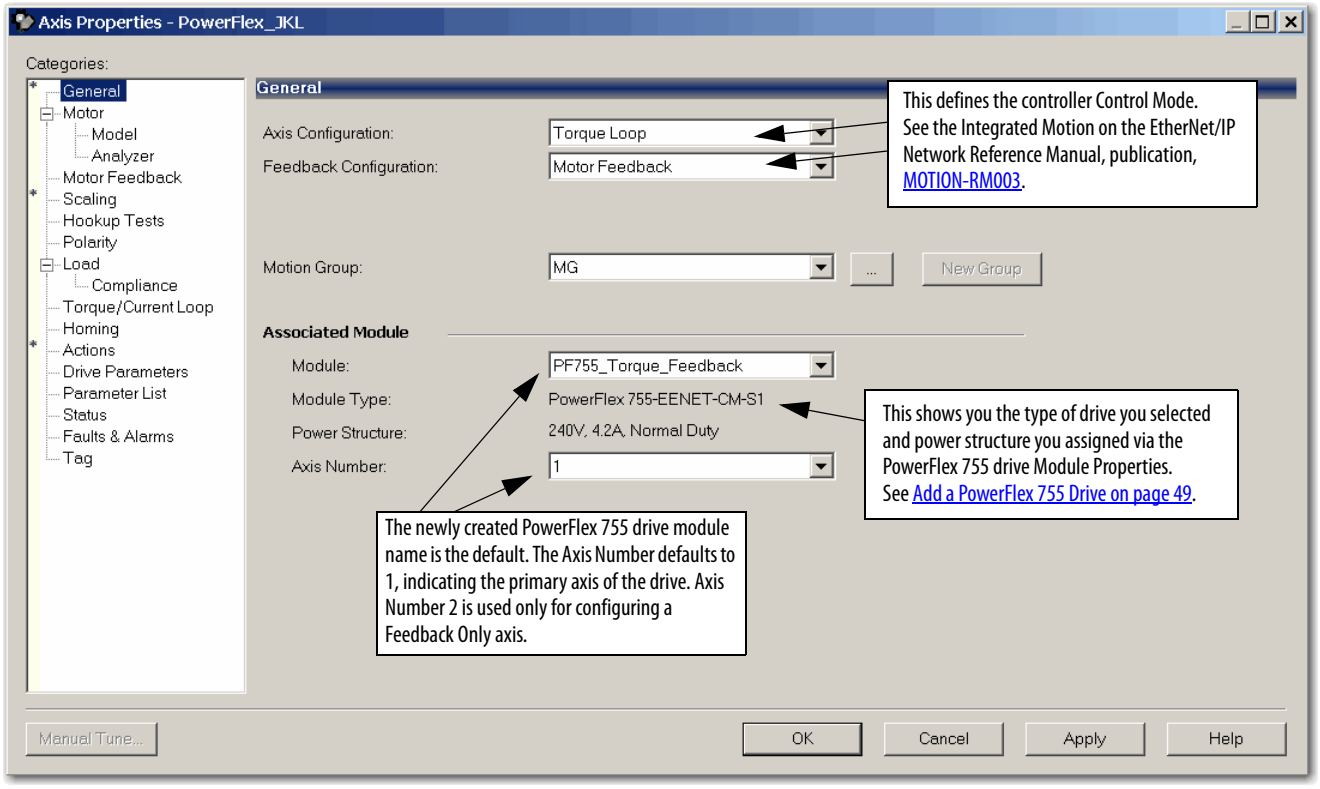
You are now finished configuring the axis for Frequency Control with No Feedback.

Example 6: Torque Loop with Feedback

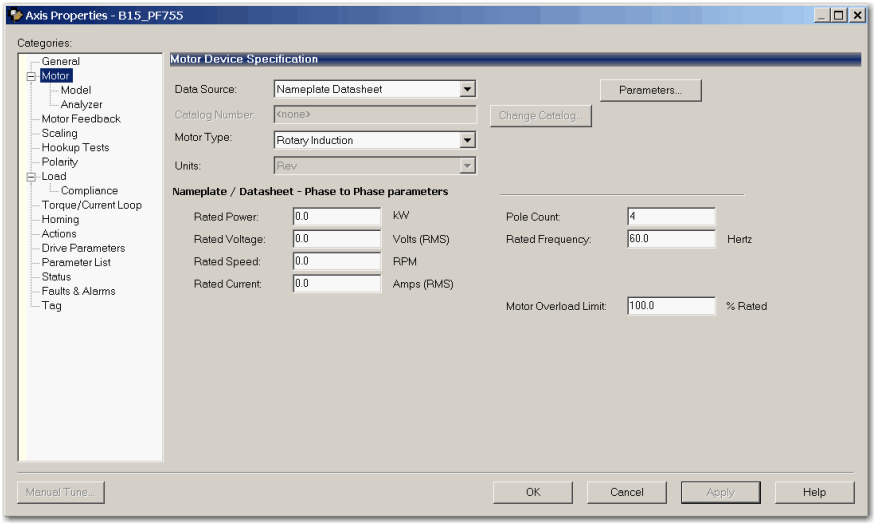
In this example, you are configuring the axis for Torque Loop with feedback.

1. Once you have created the AXIS_CIP_DRIVE axis, open the Axis Properties.
2. From the Axis Configuration pull-down menu, choose Torque Loop.
3. From the Feedback Configuration pull-down menu, choose Motor Feedback.

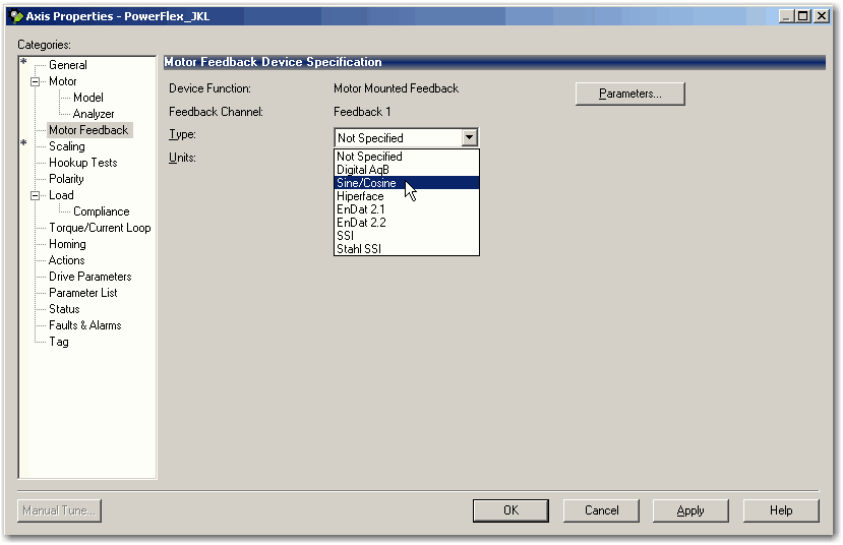
Example 6: Torque Loop with Motor Feedback, General Dialog Box



Example 6: Torque Loop with Motor Feedback, Motor Dialog Box

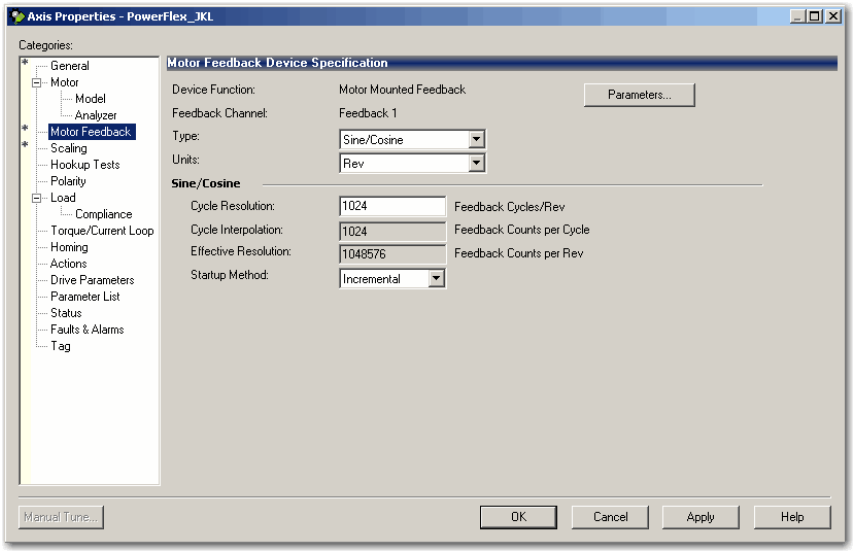


Example 6: Torque Loop with Motor Feedback, Feedback Type

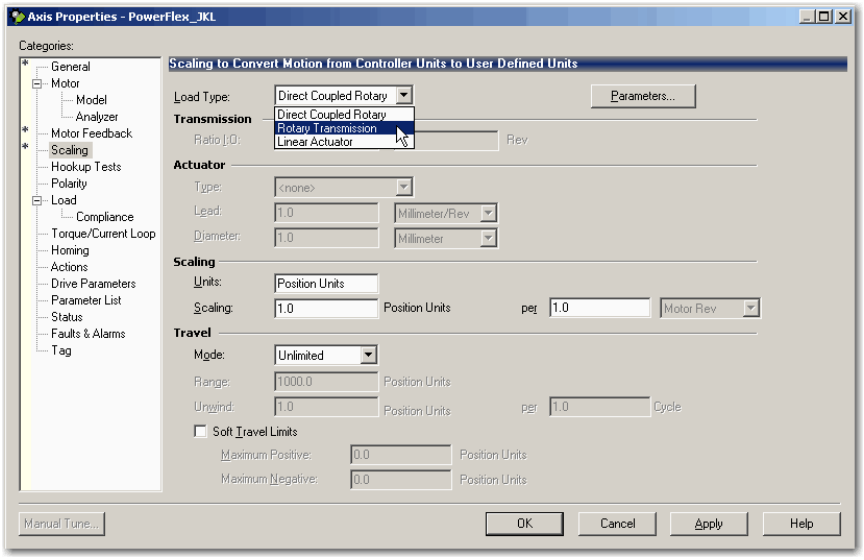


4. From the Type pull-down menu, choose the appropriate feedback type.

Example 6: Torque Loop with Motor Feedback, Feedback Type

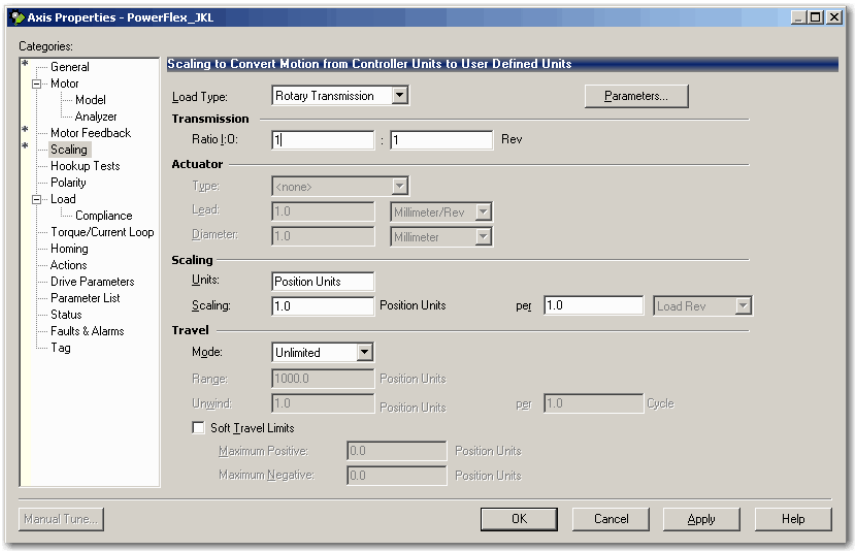


Example 6: Torque Loop with Motor Feedback, Scaling Load Type



5. From the Load Type pull-down menu, choose the appropriate load type.

Example 6: Torque Loop with Motor Feedback, Scaling Conversions



6. Enter the Transmission Ratio.
7. Enter the Scaling Units.
8. From the Travel Mode pull-down menu, choose the appropriate travel mode.

   See the Scaling Dialog Box on page 146 for more information.
9. Click Apply.

You are now finished configuring the axis for Torque Loop with Motor Feedback.

Notes:

Commission

This chapter discusses how to commission an axis for a motion application. Commissioning includes Off-line Scaling settings, downloading a project, running a Hookup Test, performing Tuning, and using the Motion Direct Commands.

Topic	Page
Scaling Dialog Box	146
Hookup Tests Dialog Box	150
Test Cable Connections, Wiring, and Motion Polarity	151
Commutation Test	156
Polarity Dialog Box	160
Autotune Dialog Box	160
Load Dialog Box	164
Load Observer Configuration	167
Test an Axis with Motion Direct Commands	170

Once you have followed the steps in Configuration Examples for a Kinetix Drive on page 99, or Configure Integrated Motion Using a PowerFlex 755 Drive on page 47, you commission the axis.

Scaling Dialog Box

Axis motion can be specified in whatever units you want. In the Scaling dialog box, you configure the motion control system to convert between raw internal motion units. For example, Feedback Counts or Planner Counts can be converted to your preferred unit of measure, be it revolutions, degrees, meters, inches, or candy bars.

This conversion involves three key Scaling Factor attributes, Conversion Constant, Motion Resolution, and Position Unwind. If you use the Scaling dialog box, the software calculates the Scaling Factors for you. The only task that you do is select the Load Type that best matches the mechanical linkage between the motor and the load.

There are four Load types:

- Direct Coupled Rotary

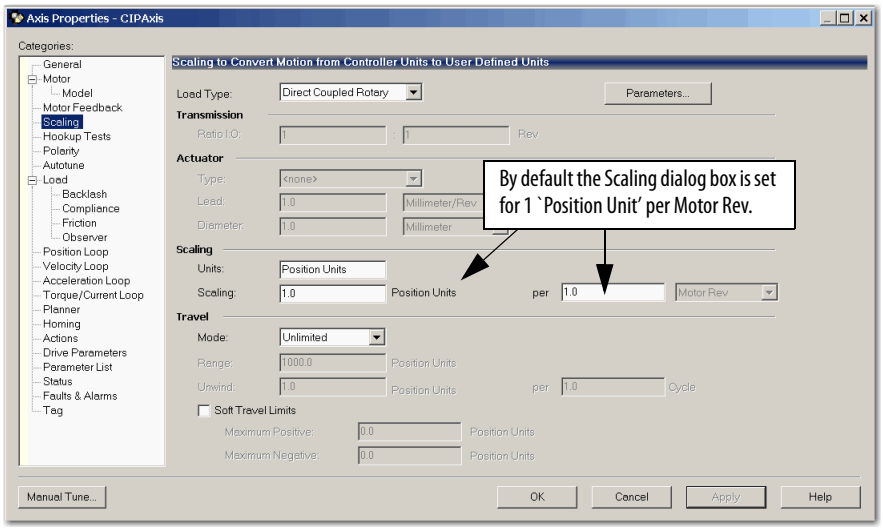
  The load is directly coupled to the linear motor moving mass.
- Direct Coupled Linear

  The load is directly coupled to the linear motor moving mass.
- Rotary Transmission

  The rotational load is coupled to the motor through a geared transmission.
- Linear Actuator

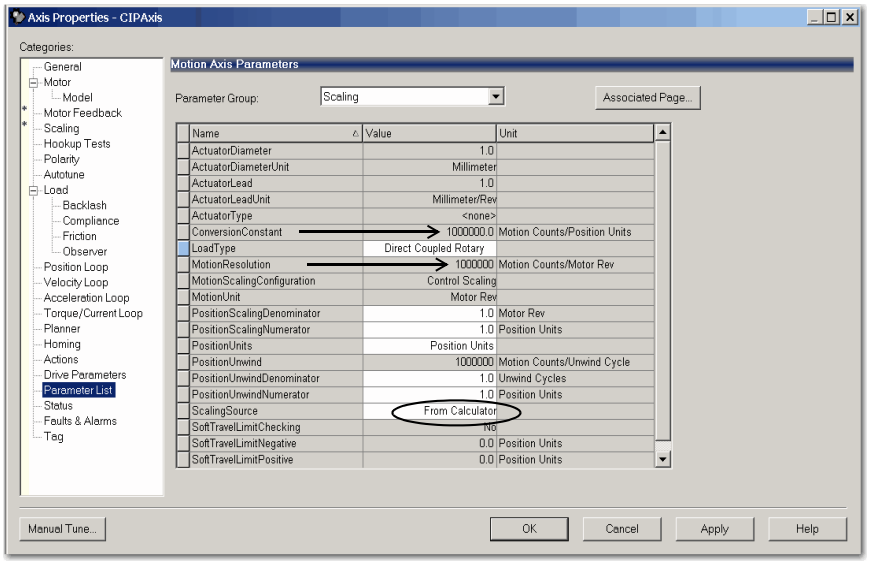
  The linear load is coupled to a rotary motor through a rotary to linear mechanical system.

This is the default Scaling dialog box for a Direct Coupled Rotary load type. By default, the Scaling dialog box is set for 1 'Position Unit' per Motor Rev.



When you click Parameters you see values for the Conversion Constant and the Motion Resolution, each having a value of 1 million. These values are generated from the software calculator.

In most cases, the software scaling calculator generates Scaling Factor values that are suitable for the application. But in rare cases, like applications that require online product recipe changes, you can set the Scaling Source attribute to Direct Scaling Factor Entry. This allows you to enter the Scaling Factors.

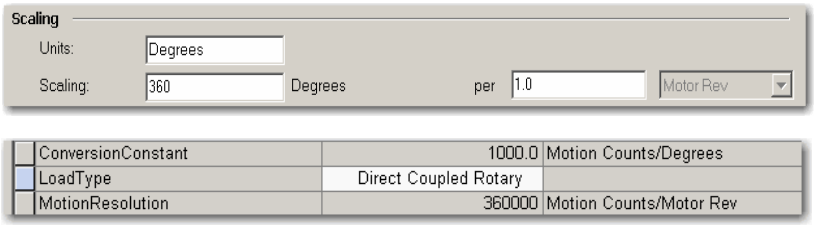


TIP In a sercos application, the Scaling Factors are Conversion Constant, Drive Resolution, and Position Unwind.

Direct Coupled Rotary

For a Direct Coupled Rotary load type, you can express Scaling Units for the rotary motor, for example, Degrees.

Here is an example of Direct Coupled Rotary load that is scaled in Degrees and the resulting values for the Conversion Constant and Motion Resolution.



Direct Coupled Linear

For a Direct Coupled Linear load type, you can express Scaling Units for the linear motor, for example, Inches.

Here is an example of Direct Coupled Linear load that is scaled in Inches and the resulting values for the Conversion Constant and Motion Resolution.

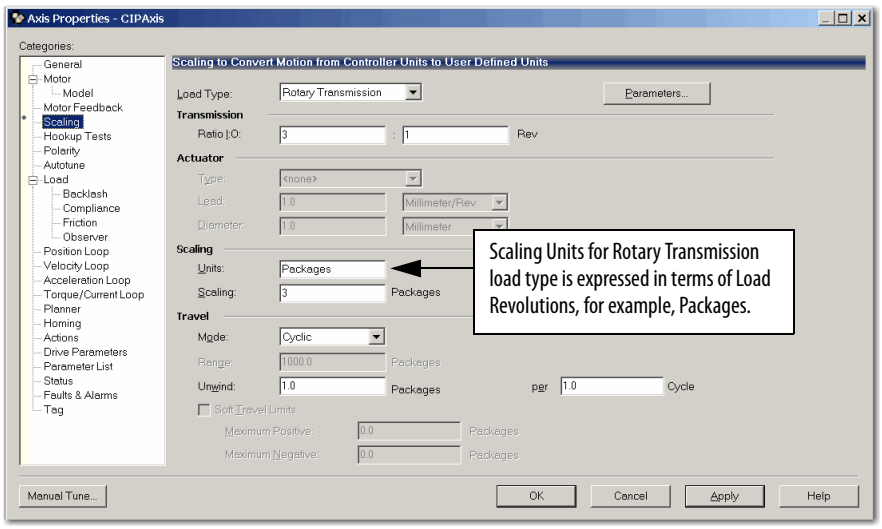
ConversionConstant	254000.0	Motion Counts/Inches
LoadType	Direct Coupled Linear	
MotionResolution	10000	Motion Counts/Motor Millimeter

For more information about Conversion Constant and Motion Resolution, see the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003.

Rotary Transmission

For a Rotary Transmission load type, you enter the Transmission ratio mechanical system. When you allow the software scaling calculator to compute the Scaling Factors by using the Transmission Ratio, it reduces the risks of cumulative errors due to irrational numbers.

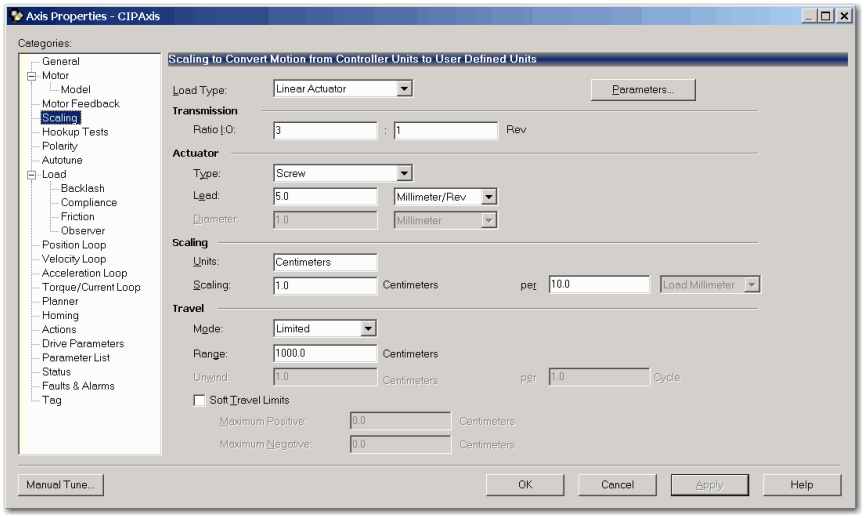
Here is an example of Rotary Transmission load scaled in Packages (three packages per Load Revolution) and the resulting values for the Conversion Constant and Motion Resolution.



ConversionConstant	100000.0	Motion Counts/Packages
LoadType	Rotary Transmission	
MotionResolution	300000	Motion Counts/Load Rev

Linear Actuator

With the Linear Actuator load type, you can specify the characteristics of the linear actuator mechanics by the Actuator Type.

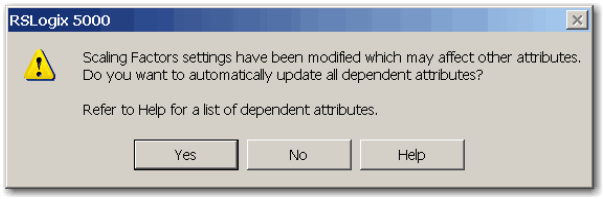


ConversionConstant	100000.0	Motion Counts/Centimeters
LoadType	Linear Actuator	
MotionResolution	10000	Motion Counts/Load Millimeter

Changing Scaling

Changing Scaling configuration factors can have a significant impact on the calculations of factory defaults for scaling dependent axis configuration attributes.

When certain criteria are met, described below, the following dialog box appears when you apply changes.


RSLogix 5000
Scaling Factors settings have been modified which may affect other attributes.
Do you want to automatically update all dependent attributes?
Refer to Help for a list of dependent attributes.
Yes
No
Help

This dialog box gives you the choice to recalculate factory defaults for scaling dependent attributes.

1. Click Yes to recalculate and apply all dependent attribute values.
2. Click No to apply only changes to the scaling attributes.

Once you have applied your configurations, the factory defaults for dynamic configuration attributes, for example, gain, limits, and filter settings are automatically computed. The calculations are based on your drive and motor configuration settings and selection for application type and loop response.

The factory defaults yield a stable operational system that can then be tailored to the specific requirements for many types of machine applications.

If you find that the gain set provided to you by the factory defaults does not satisfy your configuration requirements of your system, then you can use Autotune to improve performance.

See Autotune Dialog Box on page 160.

Hookup Tests Dialog Box

Use the Hookup Tests dialog box to check the following:

- your cabling
- adjust motor and feedback polarity
- establish your sense of positive motion direction
- and, if applicable, check encoder marker and commutation function.

To run any of the Hookup Tests, you must first download your program.

ATTENTION: These tests can actively move the axis even with the controller in remote Program mode:

- Before you do the tests, make sure no one is in the way of the axis.
- Changing motor or feedback after performing the Hookup Test can result in an axis-runaway condition when the drive is enabled.

These tasks are the run tests on the Hookup test dialog box.

- Download a program.
- Run a Hookup test to test motor and feedback device wiring.
- Run a Marker test to check for the marker pulse.
- Run a Motor Feedback test to check for feedback counts.
- Set a test distance and run a Motor and Feedback test.
- Run a Load Feedback test.
- Run a Commutation test.

The combination of the Axis and Feedback configuration types you choose determines what Hookup tests are available.

Test Cable Connections, Wiring, and Motion Polarity

Various types of Hookup Tests become available depending on what type of drive you are using and what combinations of Axis Configuration and Feedback Configuration types you choose.

Table 16 - Types of Hookup Tests

Test	Description
Marker	Checks that the drive gets the marker pulse. You must manually move the axis for this test.
Motor and Feedback	Tests the polarity of the motor, motion, load, and motor feedback.
Motor Feedback	Tests the polarity of the motor feedback.
Load Feedback	Test the load feedback polarity of the motor.
Commutation	Tests the commutation offset and polarity of a drive.
Master Feedback	Test the master feedback polarity.

This table lists the Hookup Tests that is based on axis configuration and drive type.

Table 17 - Types of Hookup Tests

Axis Type	Feedback Type	Drive(1)	Master Feedback	Motor and Feedback	Motor Feedback	Load Feedback	Marker	Commutation
Feedback Only	Master Feedback	Kinetix 5500	x				x	
		Kinetix 6500	x				x	
Frequency Control	No Feedback	Kinetix 5500		x				
		PowerFlex 755		x				
Position Loop	Motor Feedback	Kinetix 350		x	x		x	
		Kinetix 5500		x	x		x	
		Kinetix 6500		x	x		x	x
		PowerFlex 755		x	x		x	x
	Load Feedback	Kinetix 6500		x	x	x	x	
	Dual Feedback	Kinetix 6500		x	x	x	x (motor)	x (motor)
		PowerFlex 755		x	x	x	x (motor)	x (motor)
	Dual Integrated Feedback	PowerFlex 755		x	x	x	x (motor)	x (motor)
Velocity Loop	Motor Feedback	Kinetix 350		x	x		x	
		Kinetix 5500		x	x		x	
		Kinetix 6500		x	x		x	x
		PowerFlex 755		x	x		x	x
	Load Feedback	Kinetix 6500		x	x	x	x	x
Torque Loop	No Feedback	PowerFlex 755		x				
	Motor Feedback	Kinetix 350		x	x		x	
		Kinetix 5500		x	x		x	
		Kinetix 6500		x	x		x	x
		PowerFlex 755		x	x		x	x
	Load Feedback	Kinetix 6500		x	x	x	x	x

(1) For the Kinetix 5700 drive, see the Kinetix 5700 Multi-axis Servo Drives User Manual, publication 2198-UM002.

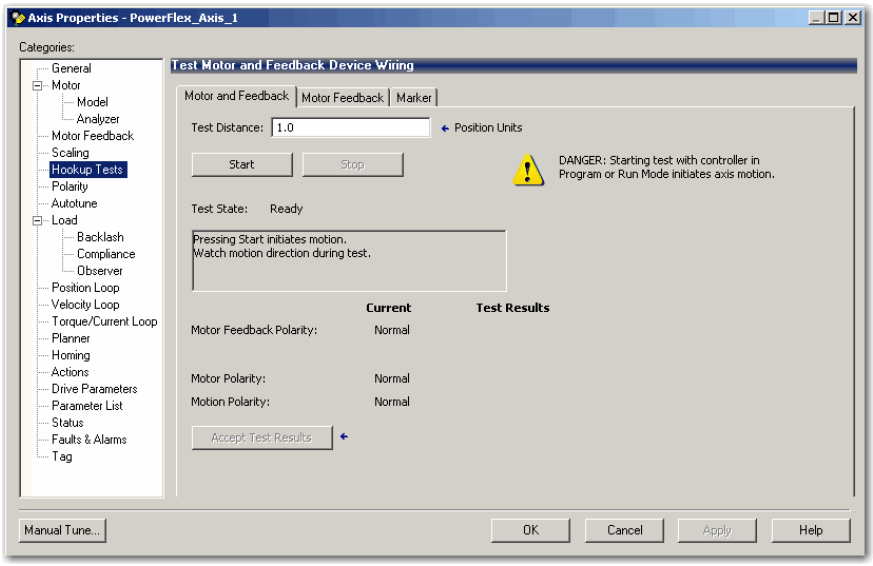
Run a Motor and Feedback Test

The Motor and Feedback Test is the most commonly used Hookup Test because it automatically tests both the motor and feedback wiring and determines correct polarity values.

ATTENTION: These tests make the axis move even with the controller in remote Program mode. Before you do the tests, make sure no one is in the way of the axis.

Follow these steps to perform a Motor and Feedback Hookup Test.

1. Go to the Hookup Tests dialog box.

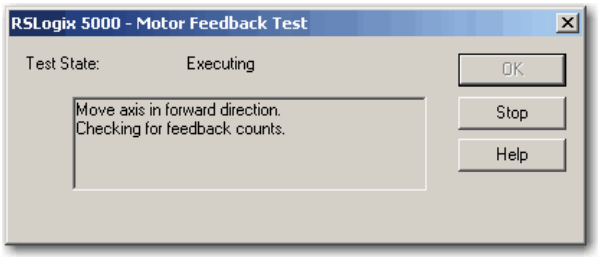


   Remember that a blue arrow next to a field means that when you change its value the new value automatically gets written to the controller when you leave the field.

2. Enter the Test Distance.

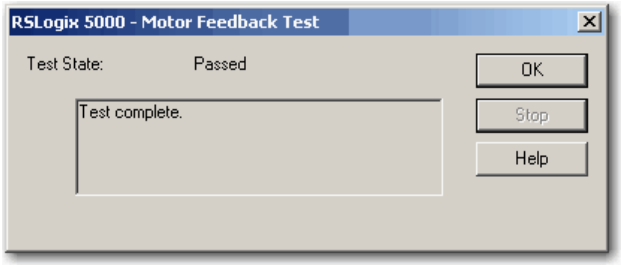
   This is the distance that the test moves the axis.

3. Click Start to run the Motor and Feedback test.

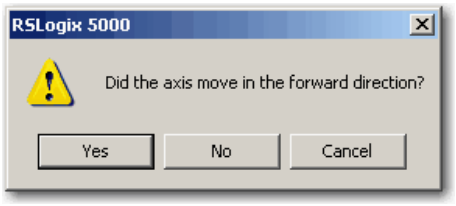


4. The axis will move on its own to test for feedback polarity and proper wiring. Watch the axis to check for proper rotation direction.

The drive determines that the feedback device is working properly and the test passed.



5. Click OK.

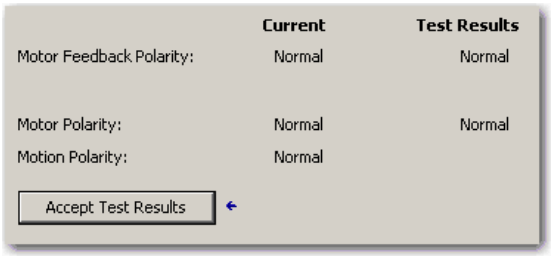


6. If your axis moved in a forward direction, click yes and you see that the test result is Normal.

   If the motor does not move in the forward direction, according to your application the test result is inverted. When you accept test results the Current shows inverted.

   See the Polarity Dialog Box on page 160.

   If you are satisfied with the results, you can accept the test results.



   The test can pass but give you results that you are not expecting. In this case, you can have a wiring problem.

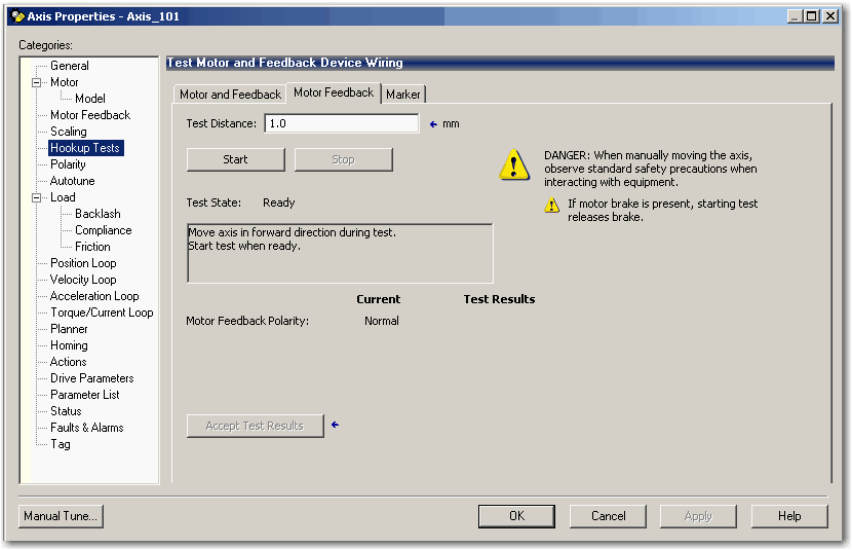
   See the related drive documentation that is listed in the Preface on page 11.

7. Click Yes or No depending on whether the axis moved in the forward direction for your application.
8. Click Accept Results, if the test ran successfully.

Run a Motor Feedback Test

The Motor Feedback Test tests the polarity of the motor feedback. Follow these steps to perform a Motor Feedback test.

1. From the Hookup Tests dialog box, click the Motor Feedback tab.

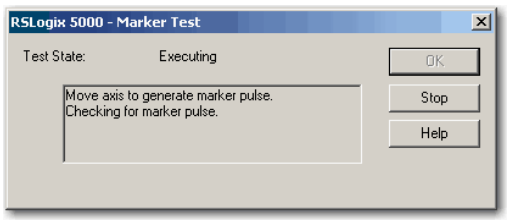


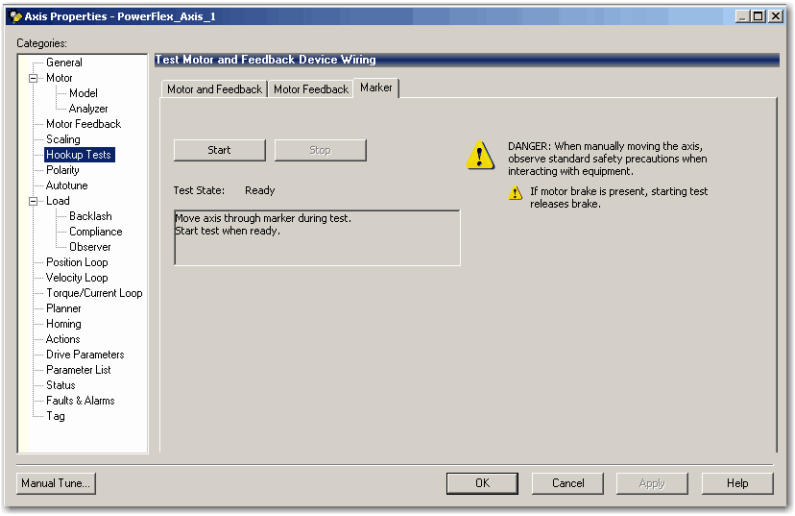
2. Enter the Test Distance.
3. Click Start.

Run a Marker Test

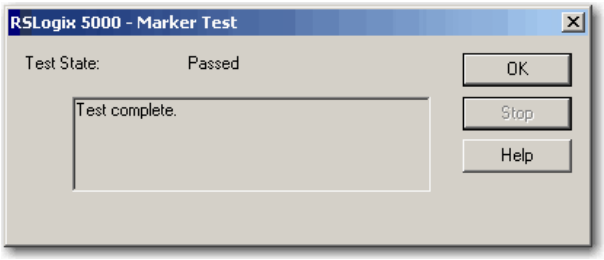
The Marker Test checks that the drive receives the marker pulse from the position feedback device. You must manually move the axis for this test. Follow these steps to perform a Marker test.

1. From the Hookup Tests dialog box.
2. Click the Marker tab.
3. Click Start to check for the marker pulse.
4. Manually move the axis until you get the marker pulse.





The drive receives the marker pulse and the test passed.



5. Click OK.

Commutation Test

The Commutation Test determines an unknown Commutation Offset and potentially the unknown polarity of the start-up commutation wiring. The Commutation Test can be used also to verify both a known Commutation Offset and the polarity start-up commutation wiring. This test is applied to third-party or custom Permanent Magnet motors that are not available as a Catalog Number in the Motion Database.

When a motor needs a Commutation Offset and you are not using Catalog number as the Motor Data Source, you cannot enable the axis.

Applying the Commutation Hookup Test

There are several different cases where the Commutation Hookup Test can be applied to a PM motor:

- Unknown Commutation Offset
- Verification of Known Commutation Offset
- Non-standard or Incorrect Wiring

Unknown Commutation Offset

The primary use for the Commutation Hookup Test is the case where the machine is equipped with a PM motor that has an unknown Commutation Offset.

The Commutation Offset, and potentially Commutation Polarity, can be unknown for different reasons, including an unprogrammed 'smart encoder' or any generic third-party encoder where Commutation Offset is unknown.

TIP The Kinetix 350 and the Kinetix 5500 drives do not support the Commutation Polarity attribute.

Verification of Known Commutation Offset

Another use of the Commutation Test is to verify that the motor is wired correctly and has the expected Commutation Offset. A machine engineer may not want to correct for a wiring error in software but rather flag a wiring error so that it may be physically corrected. Incorrect wiring of the motor power phases, encoder signal wiring, or commutation signal wiring may show up as an unexpected Commutation Offset.

For example, suppose that a motor was wired in a 'WUV' sequence instead of the normal 'UVW' sequence. The motor would still rotate in the correct direction, but the Commutation Test indicate that the Commutation Offset was off by a factor of 120 electrical degrees.

After running the Motor and Feedback Hookup Tests, you can run the Commutation Test to determine the specific Commutation Offset and Commutation Polarity. The drive executes the Commutation Test, which includes rotating the motor in the positive direction by at least one revolution. The results of the Commutation Test are reported back to compare against the known Commutation Offset and Commutation Polarity to determine if a wiring issue exists.

Non-standard or Incorrect Wiring

The Commutation Test can also be applied to a PM motor that is wired in a non-standard manner or incorrectly. In the case of incorrect wiring, it is sometimes desirable to mitigate the problem via software. This can be the case on larger machines where changing the wiring would be difficult due to the size and location of the wiring.

After running the Motor and Feedback Hookup Tests, you can run the Commutation Test to determine the specific Commutation Offset and Commutation Polarity. The drive executes the Commutation Test, which includes rotating the motor in the positive direction by at least one revolution. The results of the Commutation Test are reported back for review, and, if found satisfactory, you can accept the results as part of the controller's stored axis configuration that is sent to the drive during initialization to establish the correct wiring polarity.

Run a Commutation Test

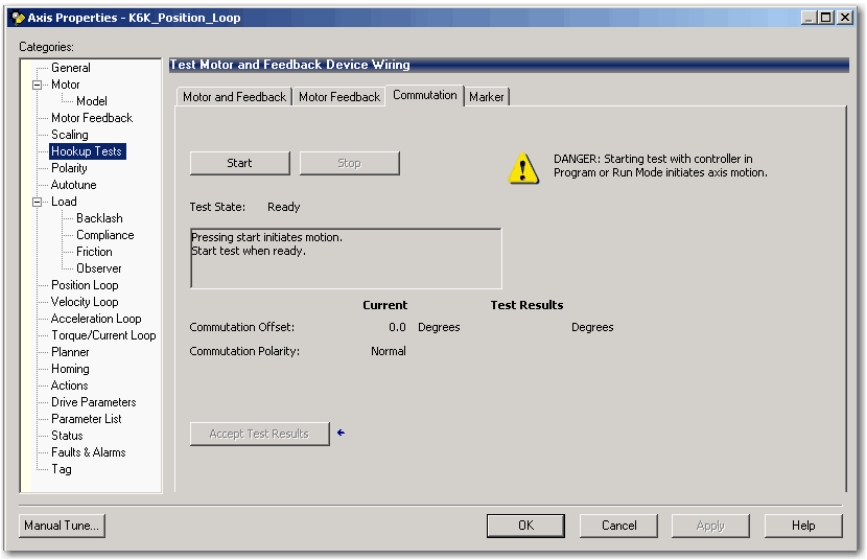
Setting the Motor and Feedback Polarity by using the Motor and Feedback Test prior to running the Commutation Test helps ensure that the motor spins in the correct direction for the Commutation Test for monitoring the Commutation Angle.

TIP You should run the Motor and Feedback Test first to determine that your feedback is working. If the Feedback is not working, the Commutation Test will give you incorrect results or the test will timeout.

Follow these steps to run a commutation test.

1. Click Start to run the Commutation Test to determine the Commutation Offset and Commutation Polarity.

   TIP The Kinetix 350 and the Kinetix 5500 drives do not support the Commutation Polarity attribute.



   The drive executes the Commutation Test, which includes rotating the motor in the positive direction by at least one revolution.

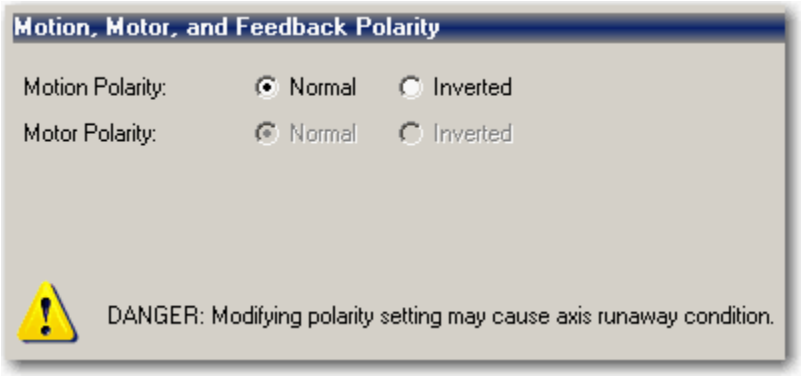
   The results of the Commutation Test appear.

2. If the results are satisfactory, click Accept Test Results.

   Commutation Offset and Polarity results are stored in the controller as part of the axis configuration that is sent to the drive during initialization.

Polarity Dialog Box

If you have run the Motor and Feedback Hookup Test, the settings on the Polarity dialog box are already correct for the application. If the polarity settings are known and cables to the motor and feedback devices are prefabricated and tested, the polarity settings can be entered on this dialog box.



At this point in the commissioning process, the axis is ready for operation. You may use Direct Commands to initiate axis motion or you may run your application program. If you find that the dynamic performance of your axis does not meet your system requirements, use Autotune to improve performance.

Autotune Dialog Box

Once you have set the parameters and performed tasks in the General, Motor, Motor Feedback, Scaling, Hookup Test, and Polarity dialog boxes, you are ready to Autotune, if needed. These steps are included in Autotune.

- Select the Application Type, Loop Response, and Load Coupling.
- Set the Travel Limit, Speed, Torque, and Direction.
- Perform Tune.
- Review results.

Autotune is optional. Typically you don't use Autotune or Manual Tune. Once you select your drive and use the Motion Database as the data source, the defaults often provide adequate tuning performance.

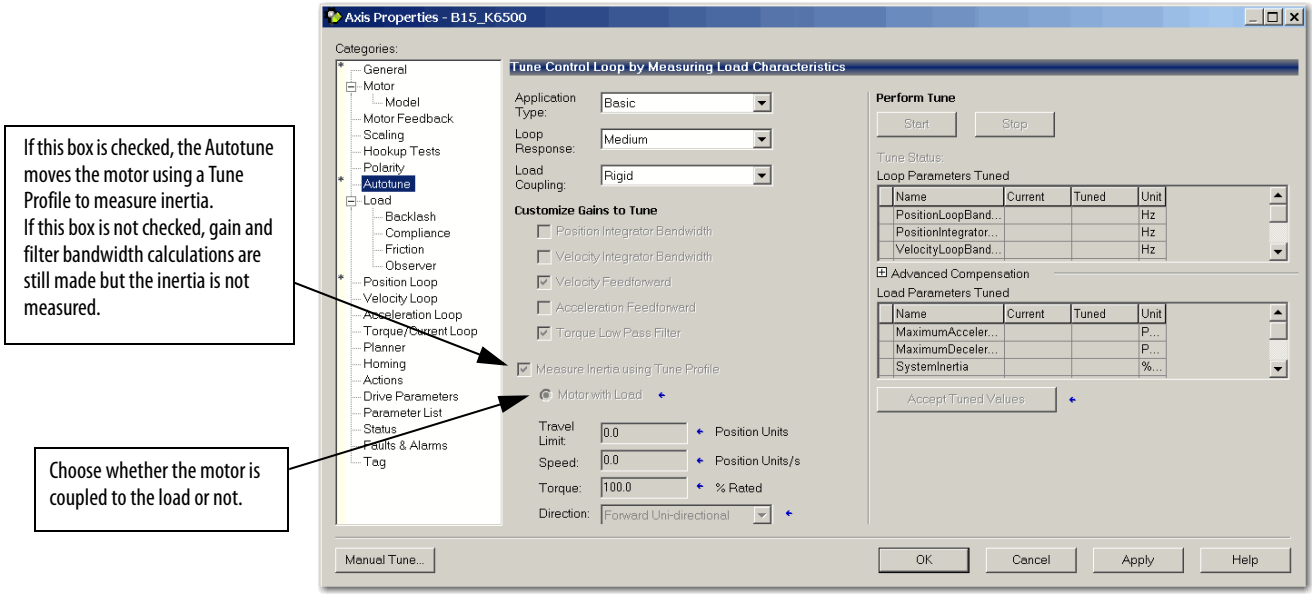
In most cases, the software default calculations are adequate and Autotune and/or Manual Tune should not be needed. Depending on the application type and axis configuration, you may need to use Manual Tune.

See Manual Tune an Axis on page 195.

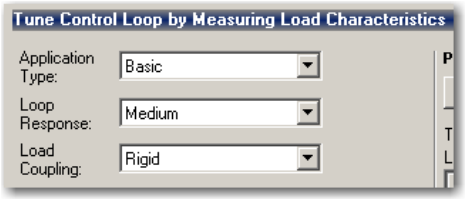
ATTENTION: When you tune an axis, it moves even with the controller in Remote Program mode. In that mode, your code is **not** in control of the axis. Before you tune an axis, make sure no one is in the way of the axis.

1. Click the Autotune dialog box.

The Application Type, Loop Response, and Load Coupling settings are conveniently grouped at the top left of the Autotune dialog box. These three attributes control the Autotune servo loop gain and filter bandwidth calculations.

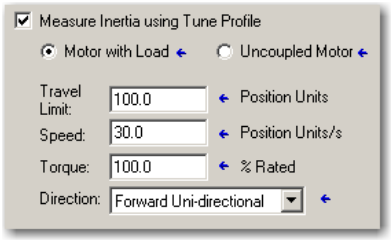


These are the same settings you made on the General dialog box. You can change them here, if desired.



Autotune normally applies a Tune Profile to briefly accelerate and decelerate the motor to measure its inertia. The measured inertia is normally used to establish the overall System Inertia. However, if the Uncoupled Motor box is checked, the measured inertia is applied to Motor Inertia attribute.

To configure the Tune Profile, you enter the Travel Limit, Speed, Torque, and Direction.



2. Set the Travel Limit that is based on the travel constraints of the machine.

3. Set the Speed to the expected operation speed.
4. Set the Torque to the level you want to apply to the motor during the Autotune.

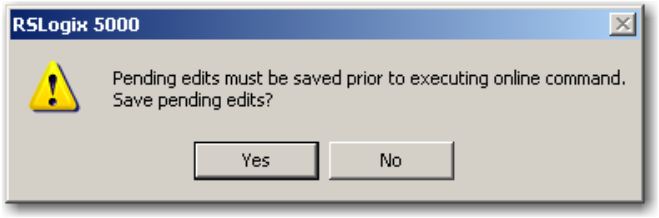
   The default of 100% Rated Torque usually give good results.
5. Set the Direction that is based on machine constrains.

   Unidirectional tune profile measures inertia and friction. Bidirectional tune profile adds measurement of active torque loading.

TIP Blue arrows next to a field means that these values are immediately applied. Once you put a value in the field and then leave that field, it is automatically sent to the controller.

6. Click Start.

   This message appears if you have edits that have not been applied. If you don't save pending edits, Autotune does not run.

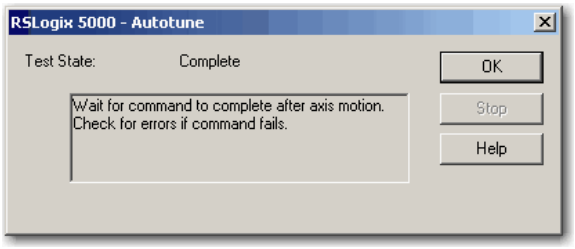


   The Autotune status should display Success. A tune configuration fault can occur if any number of attributes are zero.

Fault	Description
Tune Configuration Fault	A tune configuration fault can occur if any number of attributes are zero. This occurs only when you use Nameplate Data as the motor data source. The following attributes are checked for zero: • Tuning Torque • Conversion Constant • Drive Model Time Constant • System Damping (Damping Factor) • Rotary Motor Inertia • Linear Motor Mass – The Kinetix 350 drive does not support this attribute. • Motor Rated Continuous Current • PM Motor Rotary Voltage Constant • PM Motor Linear Voltage Constant • Rotary Motor Rated Speed • Linear Motor Rated Speed

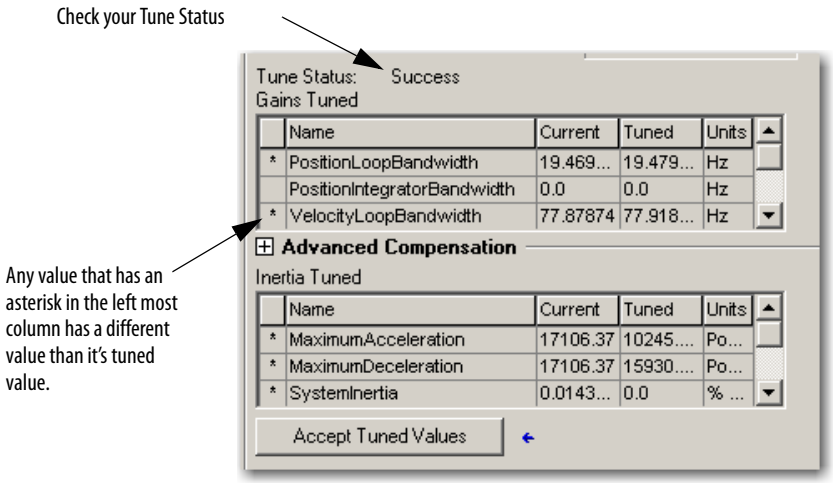
   The Autotune profile accelerates and decelerates the motor according to the Tune Direction.

Once the Autotune is finished, the test state changes.

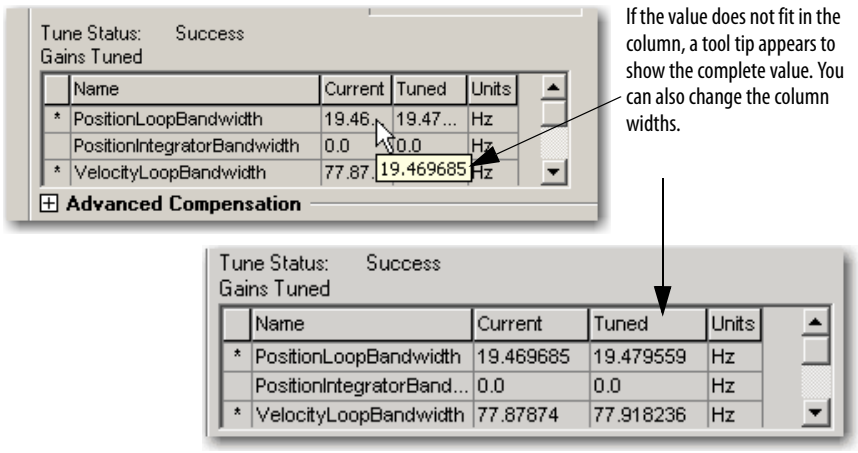


7. Click OK.

After completing the Autotune profile, the measurements that are made during this process are used to update the fields in the Gains Tuned and Inertia Tuned grids.


Check your Tune Status
Any value that has an asterisk in the left most column has a different value than it's tuned value.
Tune Status: Success
Gains Tuned
Name | Current | Tuned | Units
* PositionLoopBandwidth | 19.469... | 19.479... | Hz
PositionIntegratorBandwidth | 0.0 | 0.0 | Hz
* VelocityLoopBandwidth | 77.87874 | 77.918... | Hz
Advanced Compensation
Inertia Tuned
Name | Current | Tuned | Units
* MaximumAcceleration | 17106.37 | 10245.... | Po...
* MaximumDeceleration | 17106.37 | 15930.... | Po...
* SystemInertia | 0.0143... | 0.0 | % ...
Accept Tuned Values

8. You can compare existing and tuned values for your gains and inertias with the prospective tune values.


If the value does not fit in the column, a tool tip appears to show the complete value. You can also change the column widths.
Tune Status: Success
Gains Tuned
Name | Current | Tuned | Units
* PositionLoopBandwidth | 19.46... | 19.47... | Hz
PositionIntegratorBandwidth | 0.0 | 0.0 | Hz
* VelocityLoopBandwidth | 77.87 | 19.469685 | Hz
Advanced Compensation
Tune Status: Success
Gains Tuned
Name | Current | Tuned | Units
* PositionLoopBandwidth | 19.469685 | 19.479559 | Hz
PositionIntegratorBand... | 0.0 | 0.0 | Hz
* VelocityLoopBandwidth | 77.87874 | 77.918236 | Hz

9. Choose to accept the new values and apply them to the controller.

Now you can run the system with the new gain set and evaluate performance. You can improve the performance by adjusting application type, loop response, and/or load coupling selections.

TIP If your application requires stricter performance, you can further improve performance with manual tuning.

See Manual Tune an Axis on page 195.

Load Dialog Box

The Load dialog box contains the characteristics of the motor load. You can also use the values that are provided by autotune. Most of these values are automatically set by the Autotune:

- If you use the Catalog Number as the Data Source, the Motor Inertia, Total Inertia, and System Inertia are pre-populated with the correct values.
- If you know what the Load Ratio values are, you can enter that information on the Load dialog box or you can use the values that are provided by Autotune.

Kinetix 6500 Load Dialog Box

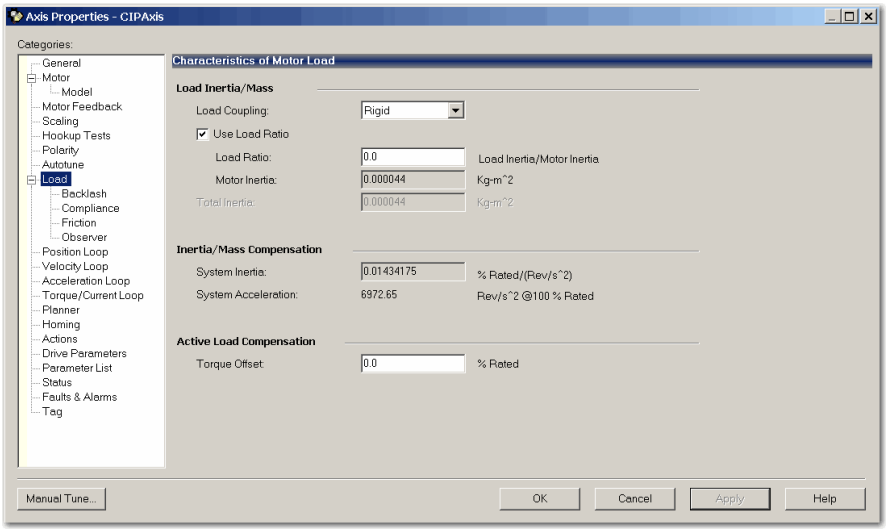


Table 18 - Load Inertia/Mass Parameter Descriptions

Parameter	Description
Load Coupling	Lets you control how tightly the system is physically coupled. Your choices are the following: • Rigid (default) • Compliant Load Coupling appears dimmed when the axis is Servo On.
Inertia Compensation	Inertia compensation controls relate to rotary motors.
Load Ratio	The Load Ratio attribute's value represents the ratio of the load inertia or mass to the motor inertia, or mass.
Motor Inertia	The Motor Inertia attribute is a float that specifies the unloaded inertia of a rotary motor. This control is calculated based on the load inertia ratio. Generally it is not equal to 0 for Kinetix drives and equal to 0 for PowerFlex 755 drives.

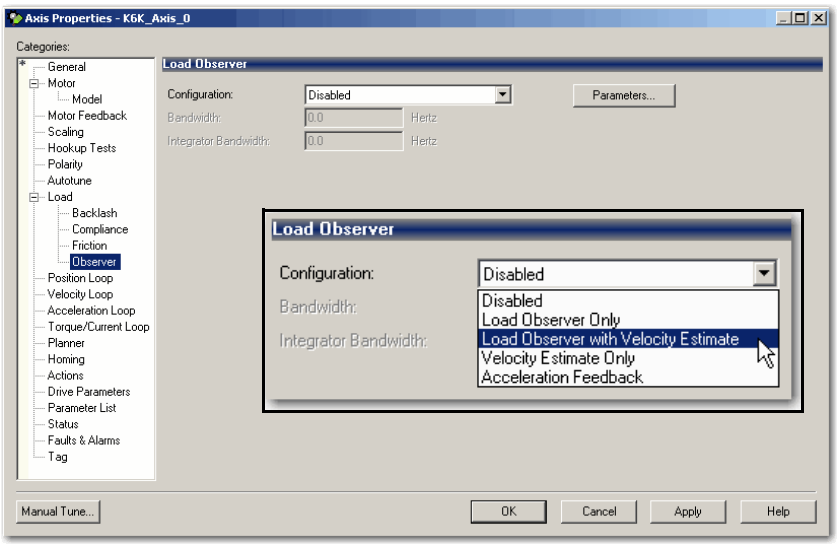
Table 18 - Load Inertia/Mass Parameter Descriptions

Parameter	Description
Total Inertia	Total Inertia represents the combined inertia of the rotary motor and load in engineering units.
Inertia/Mass Compensation	Inertia compensation controls relate to rotary motors. Mass compensation controls relate to linear motors.
System Acceleration	System Inertia is recalculated anytime the System Acceleration changes: • System Inertia = 0, if System Acceleration = 0 • System Inertia = 1/System Acceleration • Units are Rev/s^2 @100% Rated
System Inertia	The torque or force scaling gain value converts commanded acceleration into equivalent rated torque/force. Properly set, this value represents the total system inertia or mass. System Inertia is a read-only field that is based on Total Inertia. The software recalculates System Acceleration anytime the dependent attributes change: • If the data Source is Motor Catalog Number, the System Acceleration value is read directly from the motion database. • If the Data Source is Nameplate Datasheet, the System Acceleration value is calculated. • If the Data Source is Drive NV or Motor NV, this field is blank.
Torque Offset	The Torque Offset attribute provides a torque bias when performing closed loop control.
Mass Compensation	Mass compensation controls relate to linear motors.
Motor Mass	The mass of the motor displays in Kg units. This control is calculated based on the load inertia ratio. Generally it is not equal to 0 for Kinetix drives.
Total Mass	Total Mass represents the combined mass of the linear motor and load in engineering units.
Load Backlash	This provides backlash configuration options for the load of the motor. The Kinetix 350 does not support this parameter.
Load Compliance	• The Torque Low Pass Filter Bandwidth attribute is the break frequency for the 2nd order low pass filter that is applied to the torque reference signal. • The Torque Notch Filter Frequency attribute is the center frequency of the notch filter that is applied to the toque reference signal. A value of 0 for this attribute disables this feature. • The Torque Lag Filter Gain attribute sets the high frequency gain of the torque reference Lead-Lag Filter. A value greater than one results in a lead function and value less than one results in a lag function. A value of 1 disables the filter. • The Torque Lag Filter Bandwidth attribute sets the pole frequency for the torque reference Lead-Lag Filter. A value of 0 disables the filter. The Kinetix 350 does not support this parameter.
Load Friction	• Sliding Friction Compensation is the value added to the current/torque command to offset the effects of coulomb friction. • Compensation Window defines a window around the command position. The Kinetix 350 does not support this parameter.
Load Observer	This configures the operation of the Load Observer. The Kinetix 350 does not support this parameter.

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003, for detailed descriptions of the AXIS_CIP_DRIVE attributes.

Load Observer

Acceleration Control can optionally include a Load Observer. Feeding the Acceleration Reference (Kinetix 350 drive not supported) into a Load Observer, along with the velocity feedback signal, has been found to be effective in compensating for mechanical backlash, mechanical compliance, and various load disturbances. For example, the effectiveness of the Load Observer can be thought of as a result of the Observer adding virtual inertia to the motor.



The Load Observer functions as an inner feedback loop, like the current loop, but unlike the current loop in that the observer's control loop includes the motor mechanics. Due to the work of the Load Observer, variations in load inertia, mass, and even the motor's torque/force constant can be nearly eliminated as seen by the velocity loop.

Because the Load Observer includes the Acceleration Reference signal as an input, it can provide a velocity estimate signal that has less delay than the velocity feedback estimate generated by the actual feedback device. Thus, applying the Load Observer's velocity estimate to the velocity loop can be used to improve the performance of the velocity loop.

Acceleration Feedback Selection

Feedback to the Load Observer can be derived from either feedback device, Feedback 1 or Feedback 2. Which feedback source is used by the loop is governed by Feedback Mode. In general, the Load Observer works best when using a high resolution feedback device.

Acceleration and Torque Estimates

The output of the Load Observer is the Acceleration Estimate signal that is subsequently applied to the acceleration reference summing junction.

When configured for Load Observer operation, the Acceleration Estimate signal represents the error between the actual acceleration as seen by the feedback device and the acceleration that is estimated by the Load Observer that is based on an ideal model of the motor and load.

By subtracting the Acceleration Estimate signal from the output of the Acceleration Limiter, the Load Observer is forcing the actual motor and load to behave like the ideal model, as seen by the velocity loop. The Acceleration Estimate signal can be seen in this light as a dynamic measure of how much the actual motor and load are deviating from the ideal model.

Such deviations from the ideal motor model can be modeled as torque disturbances. Scaling the Load Observer Acceleration Estimate signal by the System Inertia results in the Load Observer Torque Estimate signal. This signal represents an estimate of the motor torque disturbance.

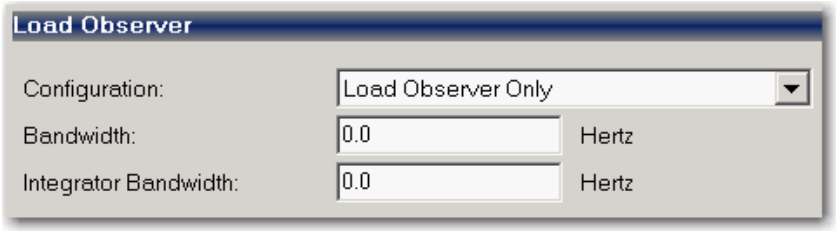
TIP The Kinetix 350 and the Kinetix 5500 drives do not support all Load Observer attributes.

When configured for Acceleration Feedback operation, the Load Observer Acceleration Estimate represents an acceleration feedback signal. Applying this signal to the acceleration reference summing junction forms a closed acceleration loop. Scaling the Load Observer Acceleration Estimate signal by the System Inertia results in the Load Observer Torque Estimate signal. This signal represents an estimate of motor torque.

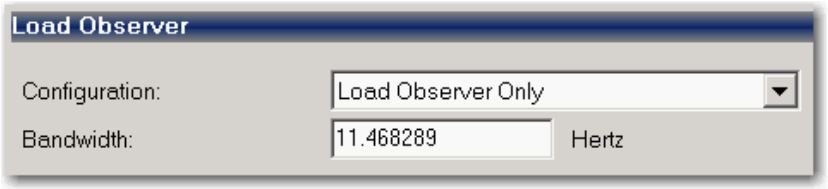
Load Observer Configuration

The Load Observer can be configured in various ways by using the Load Observer Configuration attribute. Choose 'Load Observer Only' when you want to enable the Standard Load Observer function.

Load Observer Only: Kinetix 6500 Drive

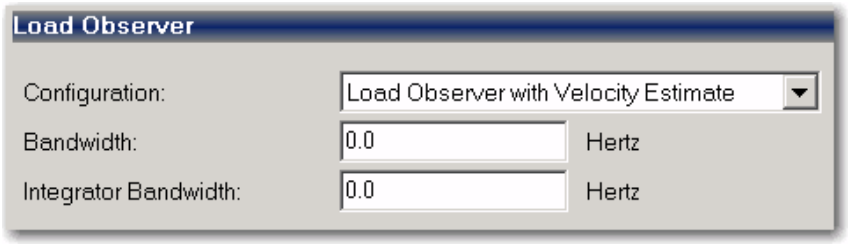


Load Observer Only: PowerFlex 755 Drive



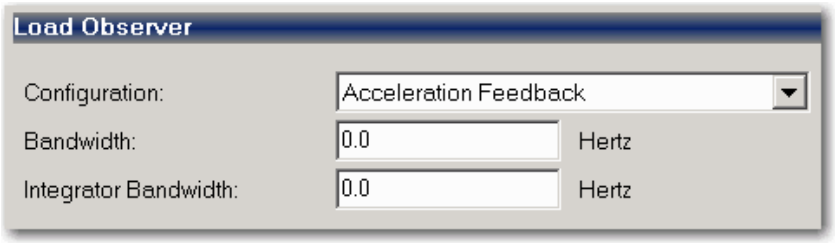
By choosing Load Observer with Velocity Estimate or Velocity Estimate Only, you can apply the Load Observer's estimated velocity signal as feedback to the velocity loop.

Load Observer with Velocity Estimate: Kinetix 6500 Drive

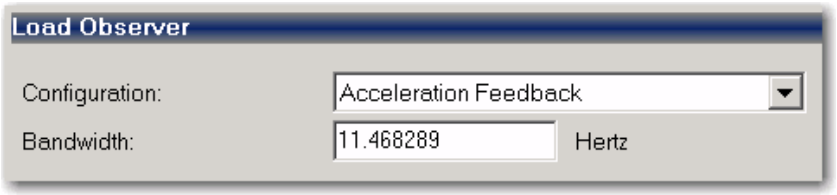


When you choose Acceleration Feedback, it degenerates the Load Observer to an acceleration feedback loop by disconnecting the Acceleration Reference input from the observer. The velocity estimate is not available in this mode of operation.

Acceleration Feedback: Kinetix 6500 Drive

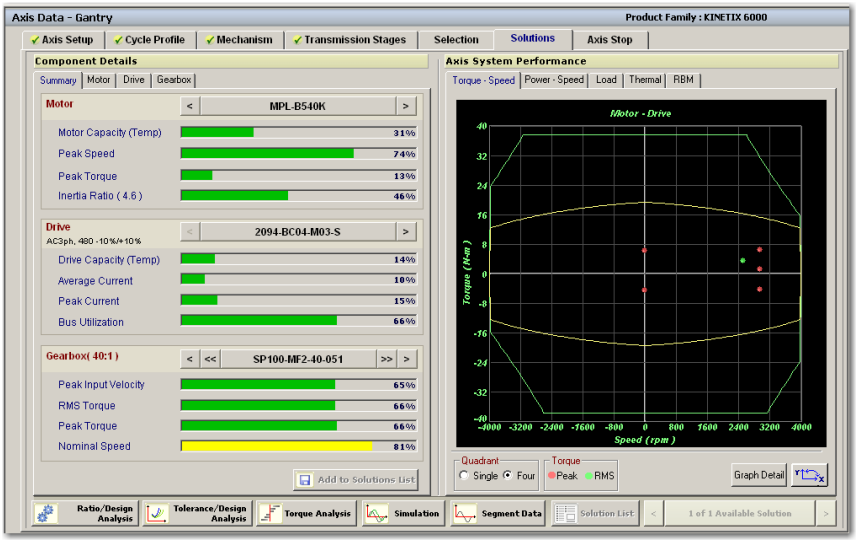


Acceleration Feedback: PowerFlex 755 Drive

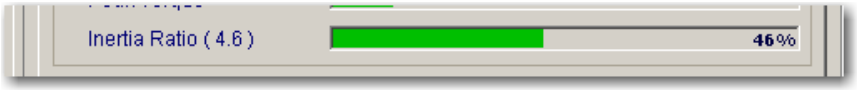


Motion Analyzer Software

Load Ratio can also be found through Autotune from Motion Analyzer.



If you don't want to run the autotune you can go to Motion Analyzer software and get the load ratio or the total inertia.



See Help for Selecting Drives and Motors on page 16 and 169 for more information about the Motion Analyzer software.

Test an Axis with Motion Direct Commands

Motion direct commands let you issue motion commands while you are online without having to write or execute an application program. You must be online to execute a Motion Direct Command. There are several ways to access the Motion Direct Command.

Motion Direct Commands (MDC) are useful when you are commissioning or troubleshooting a motion application. During commissioning, you can configure an axis and monitor the behavior by using Trends in the Controller Organizer. Use of Motion Direct Commands can fine-tune the system with or without load to optimize its performance. When testing and/or troubleshooting, you can issue Motion Direct Commands to establish or re-establish conditions such as Home. Often during initial development, test the system in small manageable areas. These tasks include the following:

- Home to establish initial conditions
- Incrementally Move to a physical position
- Monitor system dynamics under specific conditions

Access Motion Direct Commands for an Axis or Group

To access the Motion Direct Commands for the Motion Group or axis, right-click the Group or Axis in the Controller Organizer and choose Motion Direct Commands.

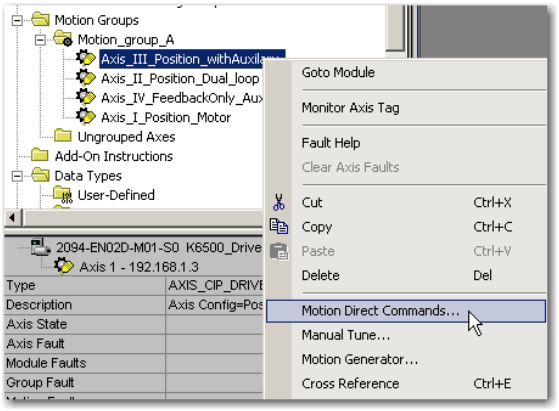
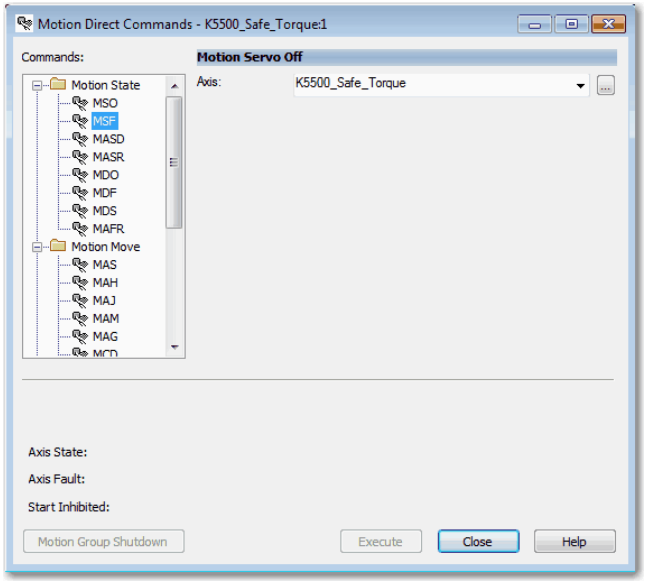
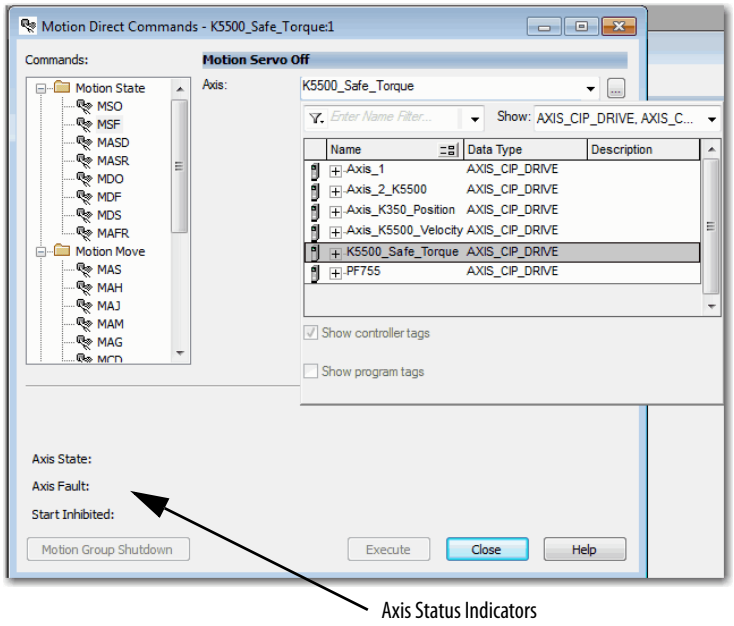


Figure 5 - Motion Direct Commands Dialog Box

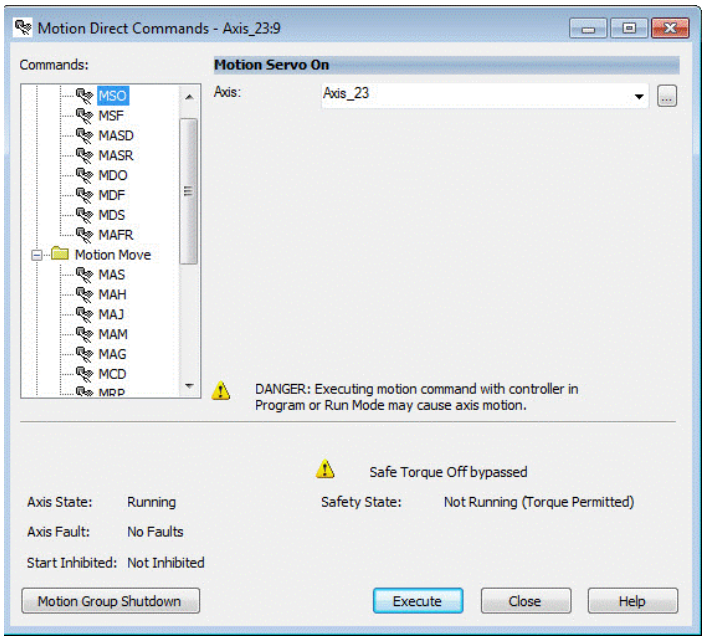


The content of the Motion Direct Command dialog box will varies, depending on the command you have chosen. In the Command list, you can either type the mnemonic and the list advances to the closest match or you can choose a command from the Axis pull-down menu. Choose the desired command and its dialog box appears.

You can access an axis by using the drop down list. Axis status indicators are located in this dialog box.



This dialog box is an example of axis indicator values.



You can also get to the commands either by right-clicking the axis and choosing Motion Generator or on the Manual Tune dialog box.

IMPORTANT	If you are using a PowerFlex 755 drive and it's configured for Velocity Mode, and you have set the Flying Start Enable attribute to true, the device starts spinning at the command velocity immediately after you execute an MDS command.

For more information about the Flying Start Attribute, see the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003.

Understanding STO Bypass When Using Motion Direct Commands

For complete information about Motion Direct Commands in motion control systems including the Safe Torque Off feature, see the Kinetix 5500 Servo Drives User Manual, publication 2198-UM001 and the Kinetix 5700 Multi-axis Servo Drives User Manual, publication 2198-UM002.

If a Safety connection between the GuardLogix safety controller and the 2198-H*xxx*-ERS2 servo drive was established at least once after the drive was received from the factory, the drive does not allow motion while the safety controller is in Program mode by default.

This is because the Safety Task is not executed while the GuardLogix safety controller is in Program mode. This applies to applications running in a single-safety controller (with Motion and Safety connections). When an integrated safety drive has a Motion connection to a standard controller and a separate Safety connection to a dual-safety controller, the standard controller can transition to Program mode while the safety controller stays in Run mode and continues to execute the Safety Task.

However, 2198-H*xxx*-ERS2 drive systems are designed with a bypass feature for the STO function in single-safety controller configurations. You can use the Motion Direct Command (MDC) feature to allow motion while following all the necessary and prescribed steps per machine safety operating procedures.

ATTENTION: Consider the consequences of allowing motion through the use of MDC when the controller is in Program mode. You must acknowledge warning messages in the Logix Designer application that warn of the drive bypassing the STO function and unintended motion can occur. The integrated safety drive does not respond to the request of STO function if MDC mode is entered.

ATTENTION: It is your responsibility to maintain machine safety integrity while executing Motion Direct Commands. One alternative is to provide ladder logic for Machine Maintenance mode that leaves the controller in Run mode with safety functions executing.

Table 19 defines which drive supports the type of STO functionality.

Table 19 - Drives Supporting STO - Safe Torque Off

Drive	Mechanism	Axis Status	STO Configuration
K6500s0	STO Hardwired	.GuardStatus	Web page
K6500s1	STO Hardwired	.GuardStatus	Web page
PF755s	STO Hardwired	.GuardStatus	Web page
PF755s1	STO Hardwired	.GuardStatus	Web page
K350	STO Hardwired	.GuardStatus	None (hardwired)
K5500ers	STO Hardwired	.GuardStatus	None (hardwired)

Table 19 - Drives Supporting STO - Safe Torque Off

Drive	Mechanism	Axis Status	STO Configuration
K5500ers2	STO Networked	.SafetyStatus	Logix K5500ers2 Profile, and Module-Defined tag.
K5700	STO Hardwired	.GuardStatus	None (Hardwired)
K5700	STO Networked	.SafetyStatus	Logix K5700ers2 Profile, K5700 is two pieces of functionality in 1 hardware package and Module-Defined tag.

Troubleshoot the Safe Torque Off Function

For complete information about troubleshooting the Safe Torque Off function, see the Kinetix 5500 Servo Drives User Manual, publication 2198-UM001and the Kinetix 5700 Multi-axis Servo Drives User Manual, publication2198-UM002.

Table 20 - 2198-Hxxx-ERS2 Servo Drive Troubleshooting

Exception Code on Drive Display	Fault Message Logix Designer	Problem	Possible Solutions
SAFE FLT S01- Safety Core Internal	CPUWatchdogFault (1)	Drive safety diagnostic detected internal STO design failure.	• Cycle control power • Return drive for repair if fault continues
SAFE FLT S03- Safe Torque Off	SafeTorqueOffFault (2)	Drive safety diagnostic detected internal STO design failure.	• Cycle control power • Execute STO function • Return drive for repair if fault continues

(1) Displayed in the Quick View Pane as Module Fault.
(2) Displayed in the Quick View Pane as Safety Fault.

Home an Axis

Homing puts your equipment at a specific starting point for operation. This starting point is called the home position. Typically, you home your equipment when you reset it for operation.

When using Integrated Motion on the EtherNet/IP network, all active and passive homes are setting absolute positions as long as an absolute device is being used.

Topic	Page
Guidelines for Homing	175
Active Homing	176
Passive Homing	176
Examples	177
Absolute Position Recovery (APR)	182

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003, for more details about the Homing attributes.

Guidelines for Homing

This table describes guidelines for homing procedures.

Table 21 - Guidelines for the Homing Procedures

Guideline	Description
To move an axis to the home position, use Active homing.	Active homing turns on the servo loop and moves the axis to the home position. Active homing also does the following: • Stops any other motion. • Uses a trapezoidal profile.
For a Feedback-only device, use Passive homing.	Passive homing doesn't move the axis: • Use passive homing to calibrate a Feedback-only axis to its marker. • If you use passive homing on a servo axis, turn on the servo loop and use a move instruction to move the axis.
For single-turn equipment, consider homing to a marker.	The marker homing sequence is useful for single-turn rotary and linear encoder applications because these applications have only one encoder marker for full axis travel.
For multi-turn equipment, home to a switch or switch and marker.	These homing sequences use a home limit switch to define the home position: • You need a home limit switch if the axis moves more than one revolution when it runs. Otherwise, the controller can't tell which marker pulse to use. • For the most precise homing, use both the switch and marker.

Table 21 - Guidelines for the Homing Procedures (Continued)

Guideline	Description
If your equipment can't back up, use unidirectional homing.	With unidirectional homing, the axis doesn't reverse direction to move to the Home Position. For greater accuracy, consider using an offset: • Use a Home Offset that is in the same direction as the Home Direction. • Use a Home Offset that is greater than the deceleration distance. • If the Home Offset is less than the deceleration distance does the following: – The axis simply slows to a stop. The axis doesn't reverse direction to move to the Home Position. In this case, the MAH instruction doesn't set the PC bit. – On a rotary axis, the controller adds one or more revolutions to the move distance. This makes sure that the move to the Home Position is unidirectional.
Choose a starting direction for the homing sequence.	Decide which direction you want to start the homing sequence in: • Positive direction—choose a Forward direction. • Negative direction—choose a Negative direction.

Active Homing

When the axis Homing mode is configured as Active, the physical axis is first activated for servo operation. As part of this process, all other motion in process is cancelled and appropriate status bits cleared. The axis is then homed by using the configured Home Sequence, which may be Immediate, Switch, Marker, or Switch-Marker. The later three Home Sequences result in the axis being jogged in the configured Home Direction and then after the position is redefined. Based on detection of the home event, the axis is automatically moved to the configured Home Position.

IMPORTANT When unidirectional active homing is performed on a rotary axis and the Home Offset value is less than the deceleration distance when the home event is detected, the control moves the axis to the unwind position of zero. This helps ensure that the resulting move to the Home Position is unidirectional.

Passive Homing

When the axis Homing mode is configured as Passive, the MAH instruction redefines the actual position of a physical axis on the next occurrence of the encoder marker. Passive homing is most commonly used to calibrate Feedback Only axes to their markers, but can also be used on Servo axes. Passive homing is identical to active homing to an encoder marker except that the motion controller does not command any axis motion.

After initiating passive homing, the axis must be moved past the encoder marker for the homing sequence to complete properly. For closed-loop Servo axes, this may be accomplished with a MAM or MAJ instruction. For physical Feedback Only axes, motion cannot be commanded directly by the motion controller, and must be accomplished via other means.

Examples

Active Homing

These examples show different ways to use active homing.

Table 22 - Active Homing Examples

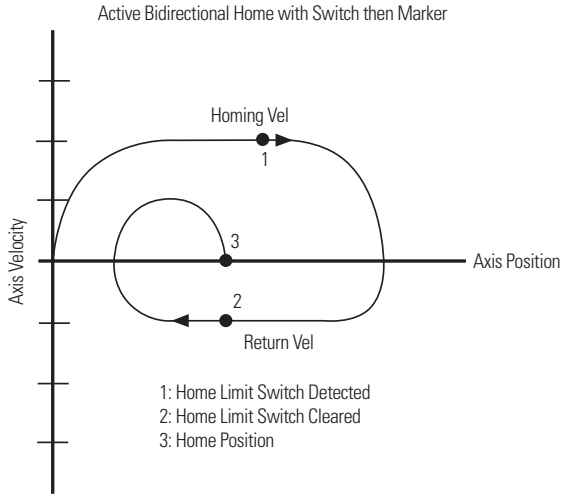
Sequence	Description
Active immediate home	This sequence sets the axis position to the Home Position without moving the axis. If feedback isn't enabled, this sequence enables feedback.
Active home to switch in forward bidirectional	The switch homing sequence is useful for multi-turn rotary and linear applications.  These steps occur during the sequence. 1. The axis moves in the Home Direction at the Home Speed to the home limit switch and stops. 2. The axis reverses direction and moves at the Home Return Speed until it clears the home limit switch and then stops. 3. The axis moves back to the home limit switch or it moves to the Offset position. The axis moves at the Home Return Speed. If the axis is a Rotary Axis, the move back to the Home Position takes the shortest path (that is, no more than a half revolution). If the axis is past the home limit switch at the start of the homing sequence, the axis reverses direction and starts the return leg of the homing sequence. Use a Home Return Speed that is slower than the Home Speed to increase the homing accuracy. The accuracy of this sequence depends on the return speed and the delay to detect the transition of the home limit switch. Uncertainty = Home Return Speed x delay to detect the home limit switch. **Example**: Suppose that your Home Return Speed is 0.1 in./s and it takes 10 ms to detect the home limit switch. Uncertainty = 0.1 in./s x 0.01 s = 0.001 in. The mechanical uncertainty of the home limit switch also affects the homing accuracy.

Table 22 - Active Homing Examples (Continued)

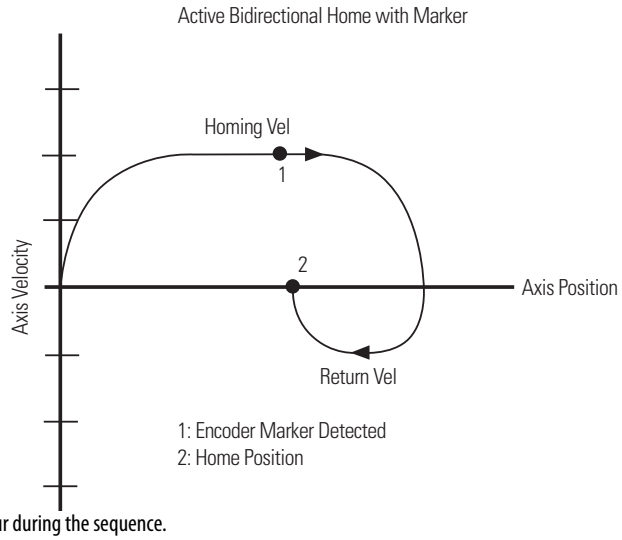
Sequence	Description
Active home to marker in forward bidirectional	The marker homing sequence is useful for single-turn rotary and linear encoder applications because these applications have one encoder marker only for full axis travel.  These steps occur during the sequence. 1. The axis moves in the Home Direction at the Home Speed to the marker and stops. 2. The axis moves back to the marker or it moves to the Offset position. The axis moves at the Home Return Speed. If the axis is a Rotary Axis, the move back to the Home Position takes the shortest path (that is, no more than a half revolution). The accuracy of this homing sequence depends on the homing speed and the delay to detect the marker transition. Uncertainty = Home Speed x delay to detect the marker. **Example**: Suppose your Home Speed is 1 in/s and it takes 1 µs to detect the marker. Uncertainty = 1 In./s x 0.000001 s = 0.000001 in.

Table 22 - Active Homing Examples (Continued)

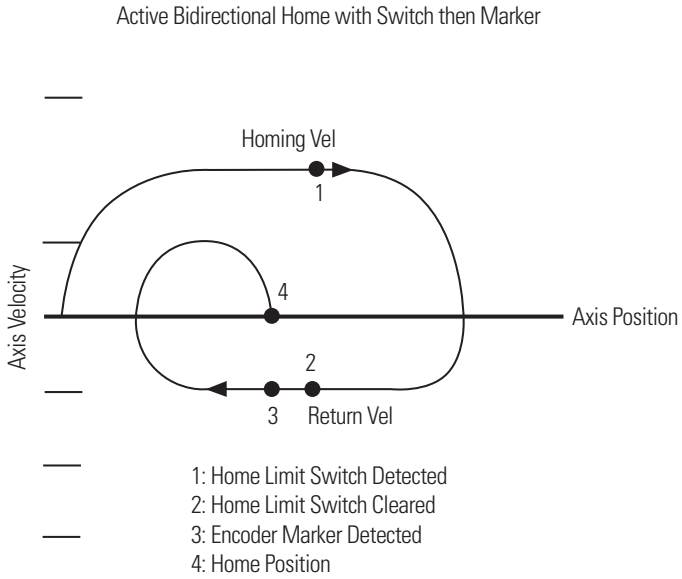
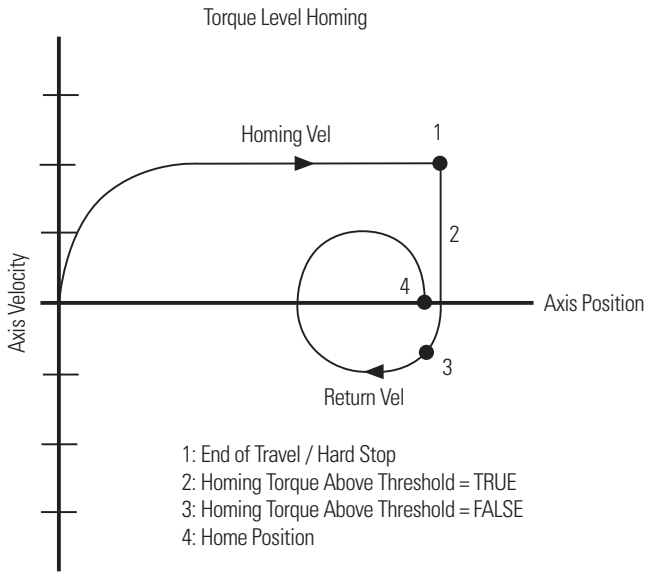
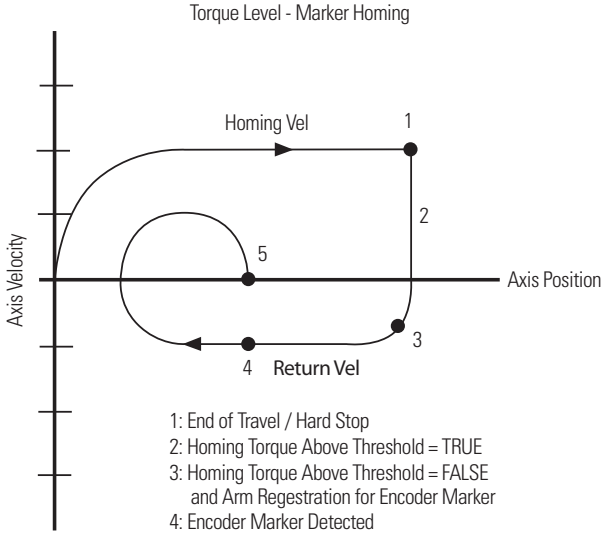
Sequence	Description
Active home to switch and marker in forward bidirectional	This is the most precise active homing sequence available.  These steps occur during the sequence. 1. The axis moves in the Home Direction at the Home Speed to the home limit switch and stops. 2. The axis reverses direction and moves at the Home Return Speed until it clears the home limit switch. 3. The axis keeps moving at the Home Return Speed until it gets to the marker. 4. The axis moves back to the marker or it moves to the Offset position. The axis moves at the Home Return Speed. If the axis is a Rotary Axis, the move back to the Home Position takes the shortest path (that is, no more than ½ revolution). If the axis is past the home limit switch at the start of the homing sequence, the axis reverses direction and starts the return leg of the homing sequence.
Active home to switch in forward unidirectional	This active homing sequence is useful for when an encoder marker is not available and either unidirectional motion is required or proximity switch is being used. These steps occur during the sequence. 1. The axis moves in the Home Direction at the Home Speed to the home limit switch. 2. The axis moves to the Home Offset position if it's in the same direction as the Home Direction.
Active home to marker in forward unidirectional	This active homing sequence is useful for single-turn rotary and linear encoder applications when unidirectional motion is required. These steps occur during the sequence. 1. The axis moves in the Home Direction at the Home Speed to the marker. 2. The axis moves to the Home Offset position if it's in the same direction as the Home Direction.
Active home to switch and marker in forward unidirectional	This active homing sequence is useful for multi-turn rotary applications when unidirectional motion is required. These steps occur during the sequence. 1. The axis moves in the Home Direction at the Home Speed to the home limit switch. 2. The axis keeps moving at the Home Speed until it gets to the marker. 3. The axis moves to the Home Offset position if it's in the same direction as the Home Direction.

Table 22 - Active Homing Examples (Continued)

Sequence	Description
Active Home to Torque	The Home to Torque Level sequence is a type of homing used when a hard stop is going to be used as the home position, as in a linear actuator. Torque Level homing is similar to Home Switch homing, with the exception that the torque level is used instead of the home switch input. This graphic depicts the Position/Velocity for Torque Level Homing.  1: End of Travel / Hard Stop 2: Homing Torque Above Threshold = TRUE 3: Homing Torque Above Threshold = FALSE 4: Home Position Torque Level-Marker homing is similar to Home Switch-Marker homing, with the exception that the torque level is used instead of the home switch input. This graphic depicts the Position/Velocity for Torque Level-Marker Homing.  1: End of Travel / Hard Stop 2: Homing Torque Above Threshold = TRUE 3: Homing Torque Above Threshold = FALSE and Arm Regestration for Encoder Marker 4: Encoder Marker Detected 5: Home Position

Passive Homing

These examples show different ways to use passive homing.

Table 23 - Passive Homing Examples

Sequence	Description
Passive Immediate Home	This is the simplest passive homing sequence type. When this sequence is performed, the controller immediately assigns the Home Position to the current axis actual position. This homing sequence produces no axis motion.
Passive Home with Switch	This passive homing sequence is useful for when an encoder marker is not available or a proximity switch is being used. When this sequence is performed in the Passive Homing mode, an external agent moves the axis until the home switch is detected. The Home Position is assigned to the axis position at the moment that the limit switch is detected. If you are using a Home Offset, then the Home Position is offset from the point where the switch is detected by this value.
Passive Home with Marker	This passive homing sequence is useful for single-turn rotary and linear encoder applications. When this sequence is performed in the Passive Homing mode, an external agent moves the axis until the marker is detected. The home position is assigned to the axis position at the precise position where the marker was detected. If you are using a Home Offset, then the Home Position is offset from the point where the marker is detected by this value.
Passive Home with Switch then Marker	This passive homing sequence is useful for multi-turn rotary applications. When this sequence is performed in the Passive Homing mode, an external agent moves the axis until the home switch and then the first encoder marker is detected. The home position is assigned to the axis position at the precise position where the marker was detected. If you are using a Home Offset, then the Home Position is offset from the point where the marker is detected by this value.

Absolute Position Recovery (APR)

APR is the recovery of the absolute position of an axis that has been machine referenced after a power cycle, or reconnection. The terms Absolute Position and Machine Reference Position are synonymous.

APR Terminology

This table describes terminology related to the APR feature.

Term	Description
Absolute Feedback Position	Position value read from an absolute feedback device.
Incremental Feedback Position	Position value read from an incremental feedback device.
Feedback Position	Value read from a feedback device, absolute or incremental.
Absolute Position Absolute Machine Reference Position Machine Reference Position	Position registers in the 1756-L6*x*(1), 1756-L6*x*S, and 1756-L7*x* controllers after the following instructions have been executed on a machine with an absolute or an incremental feedback device: • MAH, machine home • MRP, machine redefine position
A machine home/reference	Establishes a Machine Reference Offset as follows: HomeOffset = ConfiguredHomePosition - AbsoluteFeedbackPosition AbsoluteMachineReferencePosition = AbsoluteFeedback Position + HomeOffset
Absolute Position Recovery (APR)	Recovers the Absolute Machine Reference Position by maintaining the Home Offset through various scenarios as described on page 183.

(1) The 1756-L6*x* controllers are not supported in the Logix Designer application, version 21.00.00 and later.

APR Supported Components

There are differences in the way the 1756-L6*x,* 1756-L6*x*S, and the 1756-L7*x* ControlLogix controllers recover machine position:

- The 1756-L6*x* and 1756-L6*x*S controllers have a battery and use a CompactFlash card to save information.
- The 1756-L7*x* controller has a 1756-ESM*xxx* module and uses a Secure Digital (SD) card to save information.
- The 1756-L6*x* and 1756-L6*x*S series A controllers have a battery to recover the position after a power cycle but does not support APR.
- The 1756-L6 and 1756-L6*x*S series B controllers recover the position after a download or restore from CompactFlash software card or a firmware update from the ControlFLASH utility. A battery is not required.
- The 1756-L7*x* controller with a ControlLogix Controller Energy Storage Module (ESM) works the same as the 1756-L6*x* series B controller with a battery.
- The 1756-L7*x* controller without a ControlLogix Controller Energy Storage Module (ESM) works like a 1756-L6*x* series B controller without a battery.

Absolute Position Recovery Functionality

APR provides support for maintaining absolute position referenced to a specific machine, commonly called the machine referenced absolute position or just absolute position, after a power loss, program download, or firmware update.

Absolute position is established by a homing procedure initiated by successful execution of an MAH instruction. Once the homing procedure has successfully established a machine reference, the Axis Homed bit is set in the Motion Status attribute, indicating that actual position and command position now have meaning with respect to the associated machine.

It is good application programming practice to qualify dynamic machine operation with the Axis Homed bit being set. Otherwise, absolute moves to a specific position may not have any relationship to the position of the axis on the actual machine.

Because the homing procedure usually requires the machine to be taken offline and placed in a manual operating mode, for example, not making product, anything that would require you to rehome one or more axes on the machine is undesirable. This is downtime and costs money. The APR feature maintains the machine reference or absolute position through power cycles, program downloads, and even firmware updates under certain conditions.

See APR Fault Conditions on page 184 and Absolute Position Recovery Scenarios on page 187 for more details.

Absolute Feedback Device

The absolute feedback device lets absolute position be retained through a power cycle. These devices take various forms, but they all are capable of maintaining absolute feedback position while power to the drive and feedback device is off.

When power is turned back on, the drive reads the feedback referenced absolute position from the feedback device and, by applying a saved absolute offset to this absolute feedback position, the motion control system can recover the machine referenced absolute position.

Most drive products provide this capability. However, Absolute Position is generally lost if the drive is swapped out or drive firmware is updated. Integrated Motion on the EtherNet/IP network lets you recover Absolute Position through power cycles, program downloads, and firmware updates.

Sercos Versus CIP

For a SERCOS axis with absolute feedback, the drive scaling function and absolute position is maintained in the drive and therefore may be easily restored in the control after a power cycle or download of a new project by simply reading the position from the drive.

By contrast, an Integrated Motion on the EtherNet/IP network axis supports controller based scaling where absolute position is maintained in the controller's firmware. Without the work of the APR feature, absolute position would be lost after a power cycle or project download.

APR Faults

APR faults are generated during the events and when one of the conditions defined in the following APR Fault Conditions is present.

APR Fault Conditions

The axis must be in the homed state for an APR Fault to occur. The Axis Homed Status Bit must be set.

Attribute Changes

A Motion Resolution or an Axis Feedback Polarity attribute has been changed and downloaded to the controller. This can also happen during the execution of an SSV.

Axis Feedback Changes

The feedback device has been replaced. This creates an Axis Feedback Serial Number mismatch APR fault.

Axis Feedback mode has changed, for example, axis with feedback changed to axis without feedback or vice versa and downloaded to the controller.

- A user program is downloaded.
- A user program and tags are restored from the CompactFlash card.
  - Manual Restore
  - Power-up restore, when configured
- Firmware is updated via ControlFLASH software.
- An SSV to either change Feedback Polarity or one of the attributes, which results in a change to the Motion Resolution attribute.

APR Fault Generation

An APR fault that is caused by a project download, restore from a CompactFlash card, a restore from an SD card, or a ControlFLASH firmware update after one of these events:

- Axis configuration
  - Change in any of the axis attributes that impacts the absolute machine position.
- Attribute changes
  - Offline edits of the axis attributes or configuration does not cause an APR fault until after download occurs.
  - Online edits of certain attributes result in an immediate APR fault. Changing the axis feedback device or feedback polarity without downloading the project also generates an immediate APR fault.
- Axis hardware change or malfunction.
- Axis hardware resource insufficiency.
  - Hardware resource insufficiencies are detected only during download or ControlFLASH firmware update.
- Reconnection of the drive axis.

When an APR fault occurs, the actual position of the axis is set to the feedback reference position of the axis. This value is read from the absolute encoder of the axis. The APR Fault clears the axis homed status bit.

Downloading of a Project

The following checks are made during a download of a project.

1. Does the Axis already exist? If not, then it is a new axis and no APR fault will ever result will ever get generated.
2. Does the Scaling Signature match the saved Scaling Signature?
3. Does the Feedback Serial Number match the saved Feedback Serial Number?

   If these three checks pass, generally absolute position is restored.

During operation, the system monitors changes to that following attributes, which do not impact the Scaling Signature or result in the loss of the absolute machine reference and therefore does not generate an APR Fault.

- Conversion Constant
- Position Unwind
- Travel Mode

Care must be taken when changing these values so that the new values are correctly related to the Position Unit of the product and the mechanics of the system. This is typically done as part of a product recipe change. For example, when you are wrapping regular sized candy bars and then you need to change and make king sized bars, you would change the conversion constant.

If the Axis Homed status bit is clear, indicating that position has not been absolutely referenced to the machine, the APR function is bypassed and there is no attempt to restore absolute position.

There are two types of APR Faults: Standard APR Faults and RA Specific Faults. APR Faults display in the Axis Properties dialog box, Faults and Alarms.

Table 24 - Standard APR Fault Descriptions

Value	Exception	Description
1	Memory Write Error	Error in saving absolute position data to nonvolatile memory.
2	Memory Read Error	Error in reading absolute position data from nonvolatile memory.
3	Feedback Serial Number Mismatch	Position Feedback Serial Number does not match saved Feedback Serial Number.
4	Buffer Allocation Fault	Caused when there is not enough RAM memory left to save APR data.
5	Scaling Configuration Changed	Scaling attribute configuration for this axis does not match the saved scaling configuration.
6	Feedback Mode Change	Feedback Mode has changed and does not match the saved Feedback Mode configuration.

Table 25 - Rockwell Automation Specific Fault Descriptions

Value	Exception	Description
1	Persistent Media Fault	(L6x) - Means that all six sectors that are reserved for APR in persistent memory are marked as bad. This is not a recoverable fault condition: • After you get this fault, the APR feature stops working until you replace the 1756-L6*x* or 1756-L6*x*S controller. • You never get this error when using a 1756-L7*x* controller.
2	Firmware Error	Used to trap firmware errors that should never happen.

Absolute Position Recovery Scenarios

ATTENTION: Whenever memory becomes corrupt, you lose position even if you have it stored on an SD card.

This table provides detailed information on when the APR feature recovers absolute position. The following assumptions need to be considered. In each of these cases, the APR feature restores absolute position and preserves the state of the Axis Homed bit, indicating that the axis has a machine referenced absolute position:

- All relevant axes are CIP axes
- Yes, indicates that machine reference is recovered (for Axes that have been homed)
- No, indicates that machine reference is not recovered (for Axes that have been homed)

This table describes the scenarios whether the APR feature recovers absolute position. In each of these cases marked by Yes, the APR feature restores absolute position and preserves the state of the Axis Homed bit, indicating that the axis has a machine referenced absolute position.

Table 26 - APR Recovery Scenarios

Controller	Event	Machine Reference Retained
	Controller removal and insertion under power (RIUP) with a battery[1].	Yes
	Controller power cycle with battery.	Yes
	Controller Firmware Update.	Yes
	Controller update from CompactFlash card.	Yes
	Controller swap (CompactFlash card also swapped).	Yes
	Steps 1. Axes are homed. 2. Project saved to CompactFlash or SD card. 3. Axes are moved and rereferenced. 4. System restored from CompactFlash or SD card. **Result** The system absolute position is restored to rereferenced positions and the Home bit remains set.	Yes
	Steps 1. Axes are homed. 2. Project is saved to CompactFlash or SD card. 3. Same CompactFlash or SD card is used on machines 2, 3, 4 ... 4. Axes are homed on machines 2, 3, 4... at different positions. 5. System restore from CompactFlash or SD card on each machine. **Result** The system absolute position on each machine becomes restored correctly at its respective position and the Home bit remains set.	Yes
	Change controller (CompactFlash card not swapped).	No
	Change controller without a CompactFlash card.	No
	Controller power cycle without battery.	No
	Controller removal and insertion under power (RIUP) without battery.	No
	Take the controllers out of two systems with a battery or energy storage module and swap controller. There is no CompactFlash or SD cards on either controller.	No
	1. Controller remains powered. 2. Power cycle drives. 3. Change feedback device but not motor.	No
	Steps 1. Axes are homed. 2. Project is saved to a CompactFlash or SD card. 3. Memory becomes corrupt. 4. System restores from the CompactFlash or SD card. **Result** The system absolute position is lost, the axes must be rehomed, and the Home bit is cleared.	No
	Controller power cycle or removal and insertion under power without a battery or energy storage module.	No
	1. Controller and drives remained powered. 2. Hardware feedback failure on an axis.	No
	1. Battery Backed Controller. 2. User program running with an axis that is not homed.	No

Table 26 - APR Recovery Scenarios

Controller and drives remained powered	**Event**	**Machine Reference Retained**
	Disconnect and reconnect the Ethernet cable.	Yes
	Disconnect and reconnect the same feedback and/or motor cable on an axis.	Yes
	Inhibit or uninhibit an axis or drive.	Yes
Battery backed controller	**Event**	**Machine Reference Retained**
	Save to a CompactFlash[2] or SD card[3] with a homed axis and you initiate the restore.	Yes
	RIUP controller.	Yes
	Cycle power-on controller.	Yes
	Cycle power-on controller that is configured to restore user program from a CompactFlash card or SD card on power-up.	Yes
	RAM memory becomes corrupt and the user program is restored from the CompactFlash or SD card.	No
	The machine must be referenced again if RAM memory becomes corrupt. There is no way of retrieving the machine reference positions from either an SD or an SD card after machine memory becomes corrupt.	No
	User program running with a homed axis and you manually restore the user program from a CompactFlash or an SD card. If you reset the machine reference by using MAH or MRP after storing the user program to a CompactFlash or SD card, the MAH and MRP changes will not be lost. The APR is not restored to the reference stored on the CompactFlash or SD card. The APR is restored to the reference stored in RAM.	Yes
	Battery backed controller: Restore by taking the CompactFlash or an SD card to another controller. If the other controller has the exact same Axis ID and scaling constants as the CompactFlash or SD card, and has homed axes, the APR is not restored to the reference stored on the card. The APR is restored to the reference stored in RAM. The Axis ID attribute is automatically generated when you create an axis in the Logix Designer application. See The Axis ID attribute description in the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003 for more information.	Yes
Change controller	**Event**	**Machine Reference Retained**
	Transfer the CompactFlash or SD card from the first controller to the second with the following preconditions. 1. Empty the second controller. There is no user program in the second controller. 2. The user program has been saved on a CompactFlash or SD card with Integrated Motion on the EtherNet/IP network axes homed.	Yes
	Transfer the CompactFlash or SD card from the first controller to the second with the following preconditions. 1. The second controller has the same user program with the controller being swapped. 2. The second controller has axes homed.	Yes
Same controller	**Event**	**Machine Reference Retained**
	Reload the same user program from a CompactFlash or SD card. This scenario assumes that the axis is homed in RAM prior to reload.	Yes
	Update controller firmware from CompactFlash or SD card.	Yes
Controller remains powered or power cycled with battery and power cycle drives	**Event**	**Machine Reference Retained**
	Change the drive with the same or different catalog number.	Yes
	Change the motor but not the feedback device.	Yes

Table 26 - APR Recovery Scenarios

Download same program with no hardware changes	**Event**	**Machine Reference Retained**
	Change the name of an axis.	Yes
	Download the same program to the controller.	Yes
	Save As with a different filename.	Yes
	Partial Export and then import an axis.	Yes
	Added application logic.	Yes
	Download a project of an existing axis.	Yes
Download same program and no hardware changes	**Event**	**Machine Reference Retained**
	Add an axis.	No for the new axis.
	Copy or cut and paste or drag/drop axis into the same project or another project.	No for the new or pasted axis.
	Export and then import into the same or another project. **Tip:** Save the project as an .ACD file to recover the absolute position.	No
	There are changes to the axis scaling attributes.	No
Position feedback	**Event**	**Machine Reference Retained**
	The position feedback device disconnect/reconnect.	Yes
Feedback device	**Event**	**Machine Reference Retained**
	The position feedback device was disconnected or reconnected.	Yes
	The feedback device changed.	No
	The position feedback device was swap.	No
	The position feedback device failed.	No
	The position feedback polarity changed.	No
	The Feedback mode changed.	No
When any of these conditions occur, the Axis Homed bit, if set, is cleared indicating that axis position is no longer referenced to the machine. To flag the condition that the Axis Homed bit has been cleared and that the machine referenced absolute position has been lost, an APR Fault is generated. This is a recoverable fault that may be cleared via any Fault Reset or Shutdown Reset instruction.		
Restore	**Event**	**Machine Reference Retained**
	Restore from the CompactFlash card or SD card.	Yes
Inhibit or Uninhibit	**Event**	**Machine Reference Retained**
	Inhibit or uninhibit an axis.	Yes
	Inhibit or uninhibit an I/O module.	Yes
Logix Designer project	**Event**	**Machine Reference Retained**
	Import or export the project download.	No
	Download the project download of new or copied axis.	No

Table 26 - APR Recovery Scenarios

Drive	**Event**	**Machine Reference Retained**
	The drive cycled power with incremental feedback.	No
	The drive firmware updated with incremental feedback.	No
	Change the drive.	Yes
	Cycle power to the drive.	Yes
	Cycle power to the drive with absolute feedback.	Yes
	Change the motor, assuming the motor does not contain a feedback device.	Yes
	The drive firmware was update with absolute feedback.	Yes
	The drive was disconnected or reconnected.	Yes
	The drive was Inhibited or Uninhibited.	Yes
	The drive was swapped with the same feedback.	Yes
Scaling	**Event**	**Machine Reference Retained**
	Scaling signature changed. The scaling signature changed. This includes Transmission, Linear Actuator, Motion Resolution, and Motion Unit attribute changes.	No

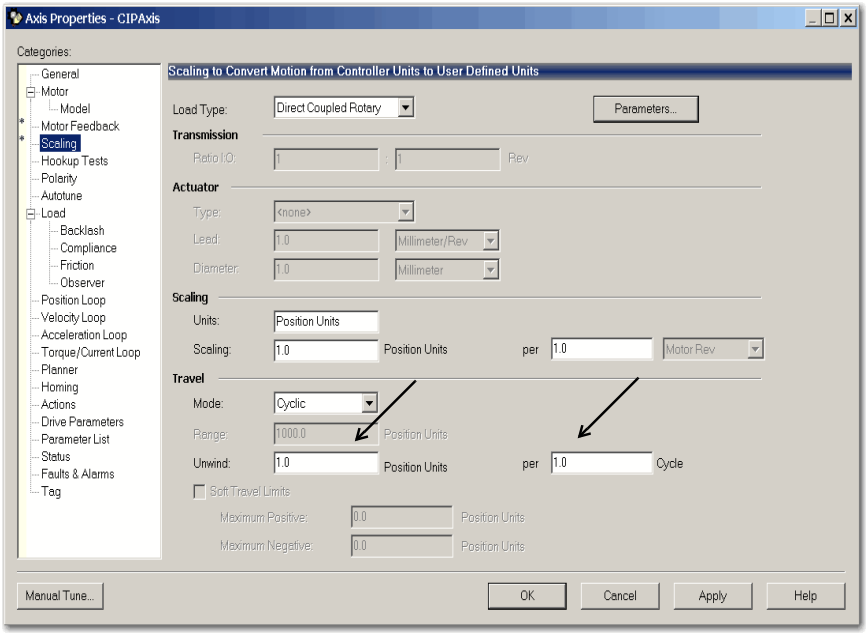
(1) The term Battery in this table assumes the 1756-L6*x* or 1756-L6*x*S controller with a battery or a 1756-L7x and a 1756-ESMxxx Energy Storage Module.

(2) 1756-L6*x* or 1756-L6*x*S controller.

(3) 1756-L7*x* controller.

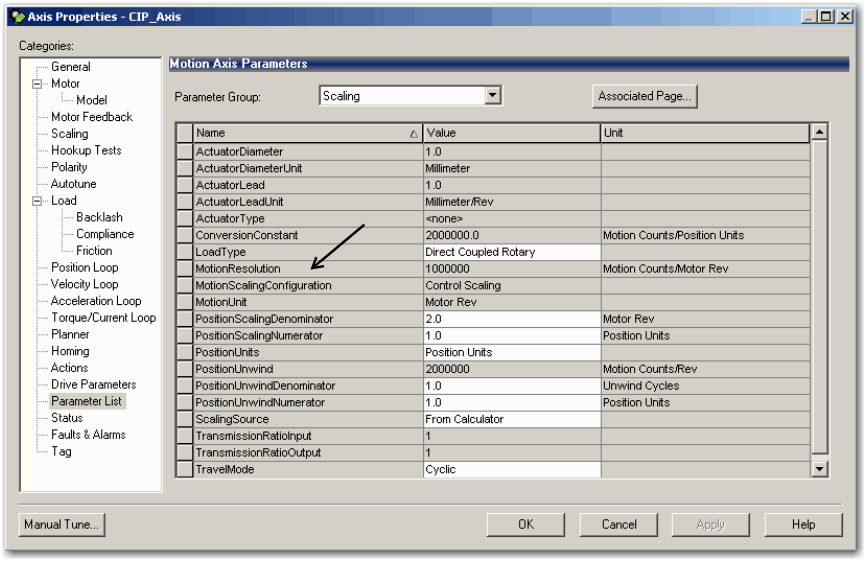
Scaling

Changing the Scaling parameters can potentially generate an APR fault because internal constants computed from these two parameters can generate a motion resolution change. If this happens, an APR fault is generated.



Online Scaling

Any change or SSV message that results in a motion resolution change can generate an APR fault.



Resetting an APR Fault

There are three ways to reset an APR Fault:

- Instruction execution:
  - Executing an MAFR
  - Executing an MGSR
  - Executing an MASR
  - Executing a MCSR
- Do the following from the Controller Organizer:
  - Clear the group fault, the software executes an MGSR
  - Clear the axis fault, the software executes an MASR
- Download the same project a second time

Absolute Position Loss without APR Faults

The Absolute Position Recovery is not retained after the following:

- A project is exported, saved as a .L5K, and imported (downloaded)
- A major non-recoverable fault (MNRF)

- A power loss

  TIP When you perform an import/export on a project in the RSLogix 5000 software, version 19 or earlier, the axis absolute position is not recovered on download to the controller.

  The APR can potentially be restored from a CompactFlash card on a 1756-L6*x* or 1756-L6*x*S controller (if a battery is not present) or an SD card on a 1756-L7*x* controller (if a 1756-ESM*xxx* module is not present) as described on page 182.

- A download of an axis that does not have its home bit set
- Power cycling of an incremental encoder

Behavior of APR for Incremental Encoders

APR for incremental encoders means Absolute Machine Reference Position Retention. When an incremental encoder is homed, the homed bit is set.

When any of the events and/or conditions that generate an APR fault for an absolute encoder occur for an incremental encoder then an APR fault is generated and the axis home bit is cleared.

For example, the behavior of APR faults for an incremental encoder is identical to that of an absolute encoder except when an incremental encoder is power cycled, and its position comes up as 0. Its Absolute Machine Reference Position is lost. An APR fault is not generated.

Saving an ACD File Versus Upload of a Project

The following is an example of a sequence of events that can generate an APR fault.

1. Make an online change to an axis attribute that generates an APR fault.
2. Rehome the axis.

   This is normally done so APR will restore axes positions after a download.
3. Save your project.
4. Download your project.

   You still get an APR fault because saving the project only uploads the tags, not the changed attributes.

IMPORTANT	You must upload the project for the changed attributes to be saved and to prevent an APR fault on a subsequent download.

Manual Tune

The Manual Tune function lets you manually improve motion performance by adjusting system bandwidth, damping factor, and drive loop gains, filters, and compensations via direct online control. Perform a manual tune when you are online with a controller to get a real-time tune of an axis.

Topic	Page
Manual Tune an Axis	195
Axis Configuration Types	196
Current Tuning Configuration	196
Additional Tune for the Kinetix 6500 Module	201
Additional Tune for the PowerFlex 755 Drive	205
Motion Generator and Motion Direct Commands	199

Manual Tune an Axis

If Autotune does not meet your system specifications, the manual tuning feature lets you customize your tuning parameters. Perform a manual tune when you are online with the controller to perform real-time adjustments to an axis. The default Application Type is Basic, which implies manual tune modifies proportional gains.

If you are not sure you need to Manual Tune, use this process:

- If the software calculation defaults are acceptable, tuning is complete.
- If the software calculation defaults are not acceptable, perform an Autotune. If the Autotune results are acceptable, tuning is complete.

  See Autotune Dialog Box on page 160 for details.
- If the Autotune results are not acceptable, perform a Manual Tune.

Axis Configuration Types

Manual Tune applies to Position Loop and Velocity Loop axis configurations. Manual Tune is not available for any other axis configurations. If you change the axis configuration to a value other than Position Loop or Velocity Loop while Manual Tune is open, the contents of the Manual Tune expander becomes disabled. This also applies to the Additional Tune functions.

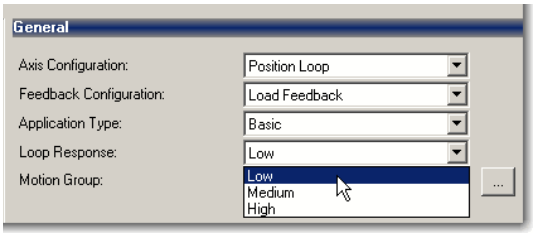
Current Tuning Configuration

Manual Tune displays the current tuning configuration. All parameters on the Manual Tuning dialog box are available while online.

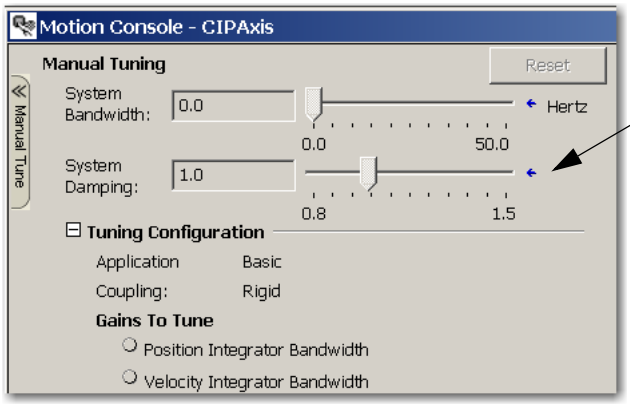
TIP In the RSLogix 5000 software, version 20 and later you can make edits when online. In the RSLogix 5000 software, version 19 and earlier, changes can only be made when online and the SERVO is enabled.

When you adjust the sliders it tells you what gains you need to update. When servo is on, the left area of the dialog box lights up. This gives you real manual tuning capability. When you expand the Tuning Configuration, you are reminded of the application type and coupling (loop response affects the system damping) you selected. These values are governing the displayed values.

There are three Loop Response settings on the General dialog box.



Loop Response relates to the following values for System Damping.
Low = 1.5
Medium = 1.0
High = 0.8

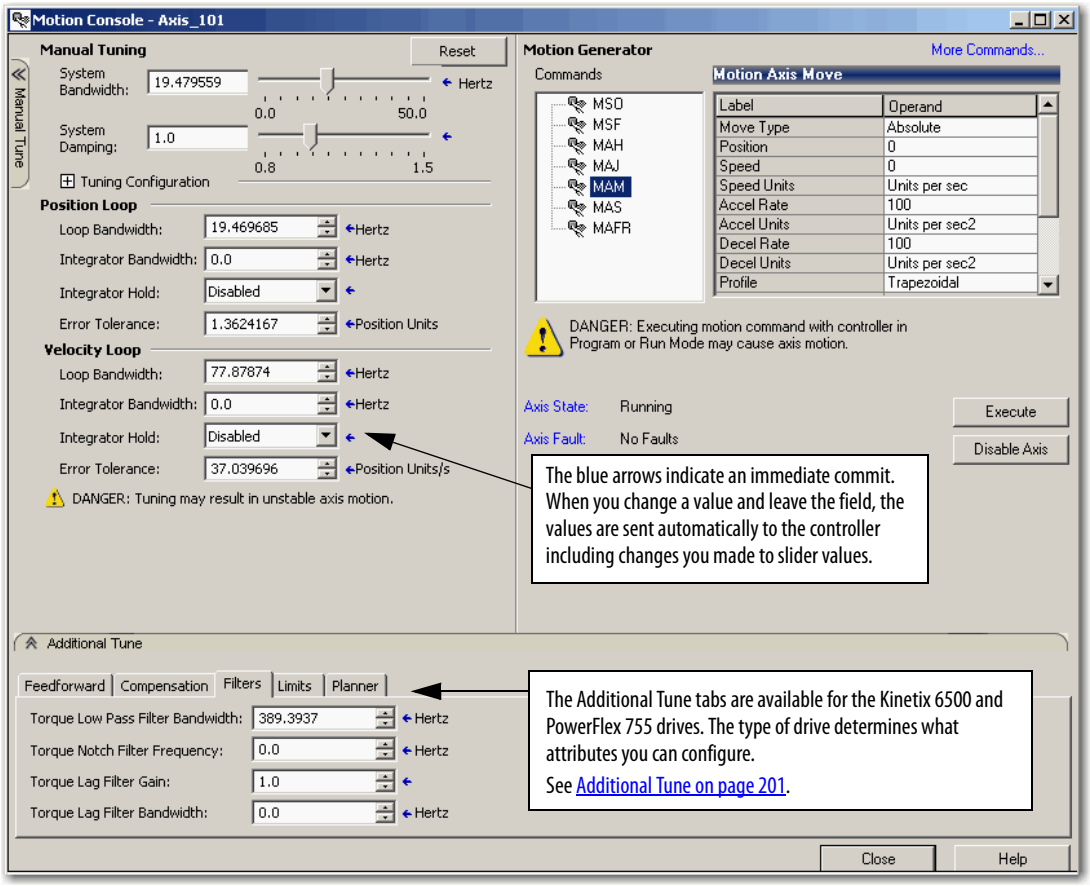


System Damping is for setting the axis Bandwidth and Error Tolerance values.

Loop Responses

This is where you can enter values for system bandwidth and system damping, which affect the loop gains. You can also individually modify the gains. The gains and filters that you have tuned by using either default factory values or Autotune are your initial values in the Manual Tune dialog box. Coupling displays how tightly set or how you chose the system to tune.

The Motion Console dialog box displays Manual Tuning and Motion Generator. Use the left of the dialog box to test in an inactive state. As you perform the tune, you can test in an active state with Motion Generator.


Motion Console - Axis_101
Manual Tuning
Reset
System Bandwidth: 19.479559 Hertz
0.0 50.0
System Damping: 1.0
0.8 1.5
Tuning Configuration
Position Loop
Loop Bandwidth: 19.469685 Hertz
Integrator Bandwidth: 0.0 Hertz
Integrator Hold: Disabled
Error Tolerance: 1.3624167 Position Units
Velocity Loop
Loop Bandwidth: 77.87874 Hertz
Integrator Bandwidth: 0.0 Hertz
Integrator Hold: Disabled
Error Tolerance: 37.039696 Position Units/s
DANGER: Tuning may result in unstable axis motion.
Motion Generator
More Commands...
Commands
MSO
MSF
MAH
MAJ
MAM
MAS
MAFR
Motion Axis Move
Label | Operand
Move Type | Absolute
Position | 0
Speed | 0
Speed Units | Units per sec
Accel Rate | 100
Accel Units | Units per sec2
Decel Rate | 100
Decel Units | Units per sec2
Profile | Trapezoidal
DANGER: Executing motion command with controller in Program or Run Mode may cause axis motion.
Axis State: Running
Axis Fault: No Faults
Execute
Disable Axis
The blue arrows indicate an immediate commit. When you change a value and leave the field, the values are sent automatically to the controller including changes you made to slider values.
Additional Tune
Feedforward | Compensation | Filters | Limits | Planner
Torque Low Pass Filter Bandwidth: 389.3937 Hertz
Torque Notch Filter Frequency: 0.0 Hertz
Torque Lag Filter Gain: 1.0
Torque Lag Filter Bandwidth: 0.0 Hertz
The Additional Tune tabs are available for the Kinetix 6500 and PowerFlex 755 drives. The type of drive determines what attributes you can configure.
See Additional Tune on page 201.
Close
Help

ATTENTION: Before you tune or test axis motion, make sure no one is in the way of the axis.

Typically motion does not occur in Program mode but you can test an axis in Remote Program mode by using Motion Direct Commands.

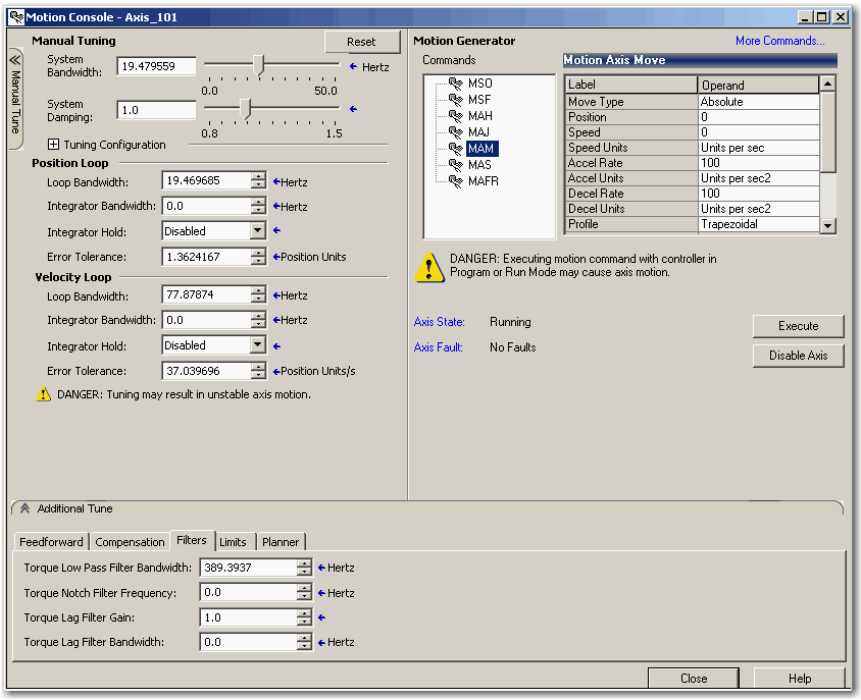
When you tune an axis, your code is **not** in control of the axis.

The tuning procedure tunes the proportional gains. Typically, tune the proportional gains first and see how your equipment runs.

Follow these instructions to manually tune an axis.

1. To open Manual Tune, do one of the following:
   - Double-click an axis while online with a controller.
   - Right-click an axis and choose Manual Tune.
   - Click Manual Tune in the lower left of any category dialog box.

   The Manual Tune dialog box appears.



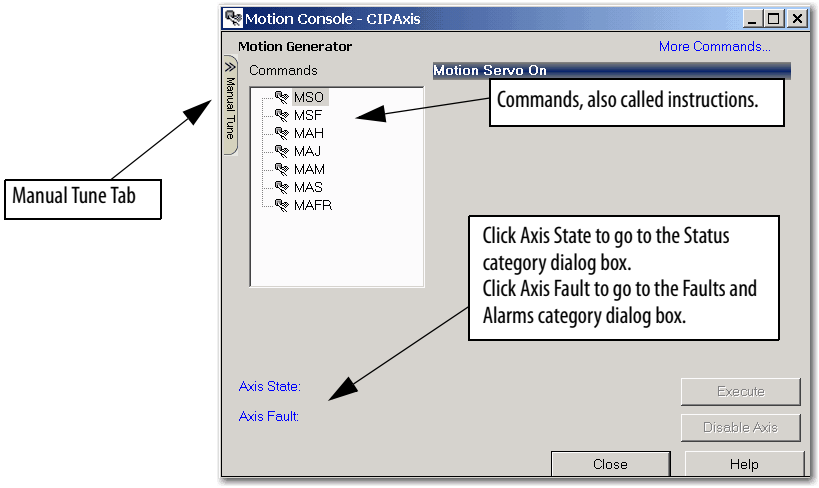
TIP When the Manual Tune dialog box appears, you may find that you cannot see all of the console. You can create more space for the console by reducing the size of the Controller Organizer or by adjusting the toolbars.

2. Adjust your settings according to your application.
3. When you make a change to a value, it is sent to the controller immediately.
4. Execute a command.
5. Watch the result.
6. Make adjustments and execute a command.

   TIP You can click Reset to return to default values.

Motion Generator and Motion Direct Commands

The commands on the Motion Generator give you basic control of a closed loop servo axis.

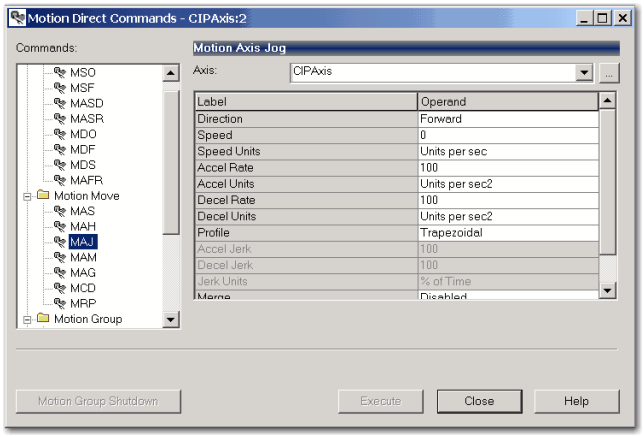


The following instructions are available are on the Motion Generator dialog box.

Table 27 - Available Instructions

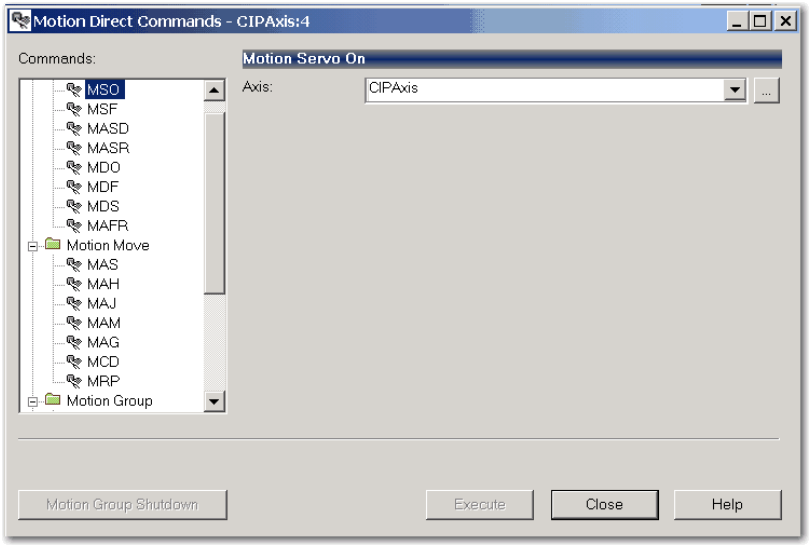
Command	Description
MDS	Motion Drive Start
MSO	Motion Servo On
MSF	Motion Servo Off
MAH	Motion Axis Home
MAJ	Motion Axis Jog
MAM	Motion Axis Move
MAS	Motion Axis Stop
MAFR	Motion Axis Fault Reset

When you click the More Commands link on the Motion Generator, you are taken to the Motion Direct Commands dialog box. In this dialog box, you can observe the effects of the manual tune. You can turn the axis on and off, home and move the axis, and resetting faults.



Follow these instructions to use a Motion Direct Command.

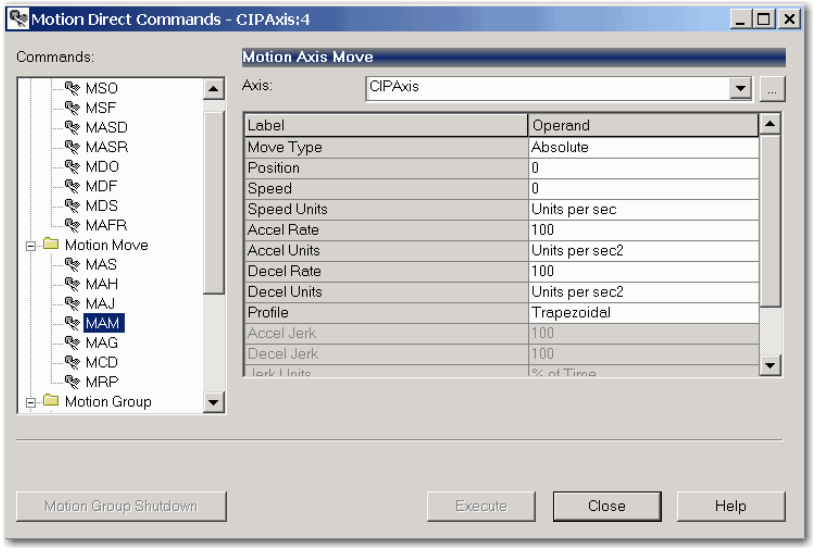
1. Select MSO (Motion Servo On) and click Execute.



2. Click Reset.

   Reset restores all values that were there when you first opened Manual Tune.

3. Select MAM (Motion Axis Move) and click Execute.



4. Click Execute.

   Your drive moves according to your configuration settings.

5. Adjust your settings, if desired.

6. Select another command and click Execute.

Additional Tune

The Additional Tune tabs are available for both the Kinetix 6500 and PowerFlex 755 drives. The attributes that appear on the tabs are determined by the type of drive you are using.

See the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003, for detailed information about the AXIS_CIP_DRIVE attributes.

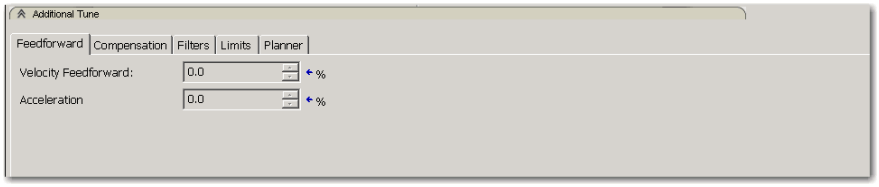
Additional Tune for the Kinetix 6500 Module

The Additional Tune section gives you access to additional tuning parameters, typically needed for more advanced servo loop settings. Additional Tune for the Kinetix 6500 module provides access to five parameter tabs:

- Feedforward
- Compensation
- Filters
- Limits
- Planner

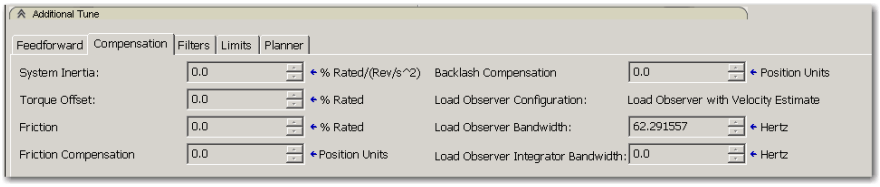
TIP You may need to turn all your toolbars off to see the complete screen. When you're done, choose View>Toolbars>Factory Defaults, or turn on the toolbars you want to see.

The Feedforward tab lets you adjust velocity and acceleration feedforward.



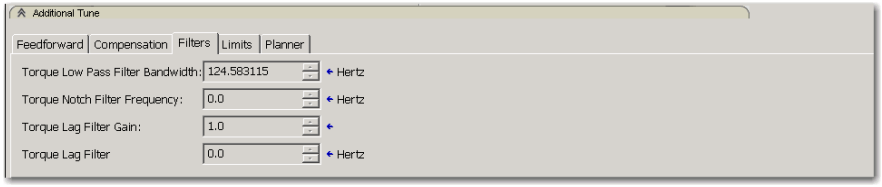
Attribute	Description
Velocity Feedforward Command	A command signal that is a scaled version of the command velocity profile.
Acceleration Feedforward Command	A signal that is a scaled version of the command acceleration profile.

The Compensation tab lets you input scaling gain and friction offset values.



Attribute	Description
System Inertia	Torque or force scaling gain value that converts commanded acceleration into equivalent rated torque/force.
Torque Offset	Provides a torque bias when performing closed loop control.
Friction	Value added to the current/torque command to offset the effects of coulomb friction.
Friction Compensation	Value added to the current/torque command to offset the effects of friction. The Kinetix 350 drive does not support this parameter.
Backlash Compensation	Defines a window around the command position.
Load Observer Configuration	Configures the operation of the Load Observer.
Load Observer Bandwidth	Determines the proportional gain, Kop, of the load observer.
Load Observer Integral Bandwidth	Determines the load observer integral gain, Koi, that together with the Kop, multiplies the integrated error signal within the observer.

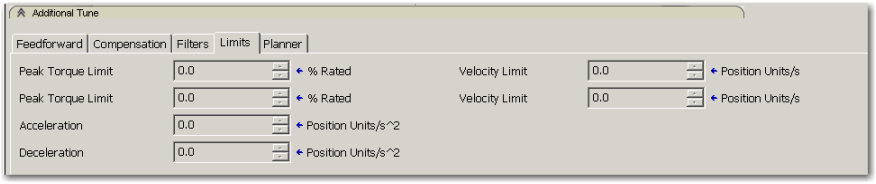
The Filters tab lets you input torque values.



Attribute	Description
Torque Low Pass Filter Bandwidth	Break frequency for the second order low pass filter that is applied to the torque reference signal.
Torque Notch Filter Frequency	Center frequency of the notch filter that is applied to the toque reference signal.
Torque Lag Filter Gain	Sets the high frequency gain of the torque reference Lead-Lag Filter.
Torque Lag Filter	Sets the lag filter that is applied to the torque reference filter.
Adaptive Tuning Configuration	Configured advanced gain tuning options. The modes for the adaptive tuning include: • Disabled • Notch Filter Tuning • Gain Stabilization • Notch Filter Tuning and Gain stabilization

Attribute	Description
Torque Notch Filter High Frequency Limit	The high frequency limit for vibration suppression. The value must be greater than the Torque Notch Filter Low Frequency Limit value. The default Torque Notch Filter High Frequency limit is 1000 Hertz
Torque Notch Filter Low Frequency Limit	The low frequency limit for vibration suppression. The value must be less than the Torque Notch Filter High Frequency Limit value. The default Torque Notch Filter Low Frequency limit is 100 hertz.
Torque Notch Filter Tuning Threshold	Enter a threshold valued for the resonance frequency identified by the tuning algorithm. The magnitude of an identified natural resonance frequency must be higher than this threshold value to be applied to the Torque Notch Filter Frequency estimate. The default value is 5.0% Motor Rated.

The Limits tab lets you input peak, velocity, and accel/decel values.



Configure Torque Values

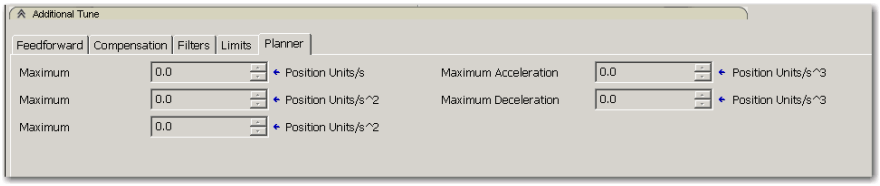
The torque values are additional tuning parameters that are typically needed by more advanced servo loop settings. The values that appear are determined by the type of drive you are using.

Follow these steps to configure torque values:

1. Right-click an axis and click Manual Tune.
2. In the bottom left corner of the Manual Console dialog box, click Additional Tune to display the additional tune tabs.
3. Click the Filters tab to access the torque values.
4. Adjust the torque values as desired.
5. After you adjust the values, click Additional Tune to close the tabs.

Attribute	Description
Peak Torque Limit	Floating point that is based on calculations using Max Motor Torque, Max Drive Torque, Motor Peak Current, Motor Rated Current, and Drive Peak Current attributes.
Velocity Limit	Positive or Negative velocity reference value.
Acceleration	Defines the maximum acceleration (increasing speed) allowed for the acceleration reference value into the acceleration summing junction. The Kinetix 350 does not support this attribute.
Deceleration	Defines the maximum deceleration (decreasing speed) allowed for the acceleration reference signal into the acceleration summing junction.

The Planner tab lets you input the maximum values for acceleration and deceleration.



Attribute	Description
Maximum	The value of the Maximum Speed attribute used by various motion instructions to determine the steady-state speed of the axis.
Maximum Acceleration and Maximum Deceleration	The Maximum Acceleration and Maximum Deceleration values frequently used by motion instructions, for example, MAJ, MAM, and MCD, to determine the acceleration/deceleration rate to apply to the axis.

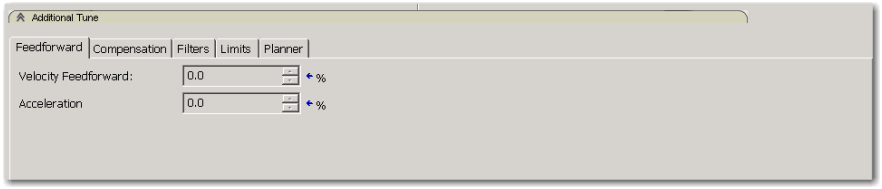
Additional Tune for the PowerFlex 755 Drive

The Additional Tune section gives you access to additional tuning parameters, typically needed for more advanced servo loop settings. Additional Tune for the PowerFlex 755 drive provides access to five parameter tabs:

- Feedforward
- Compensation
- Filters
- Limits
- Planner

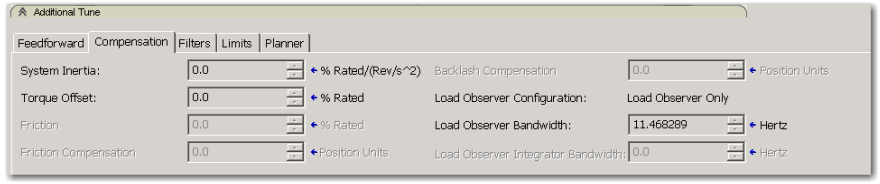
TIP You may need to turn all your toolbars off to see the complete screen. When you're done, choose View>Toolbars>Factory Defaults, or turn on the toolbars you want to see.

The Feedforward tab lets you adjust velocity and acceleration feedforward.



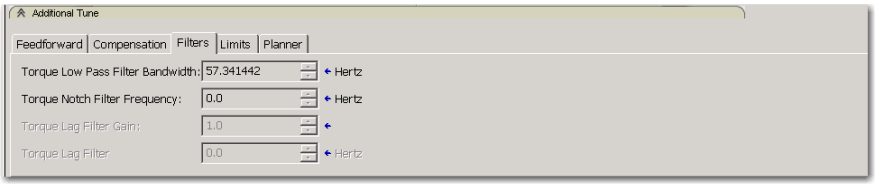
Attribute	Description
Velocity Feedforward	A command signal that is a scaled version of the command velocity profile.
Acceleration	A signal that is a scaled version of the command acceleration profile.

The Compensation tab lets you input scaling gain and friction offset values.



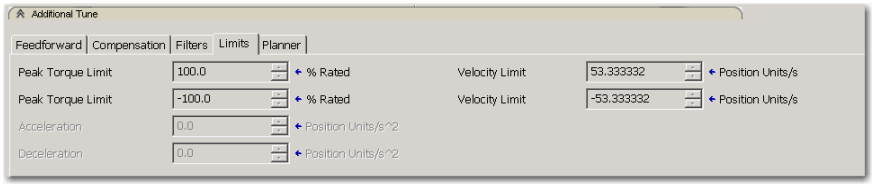
Attribute	Description
System Inertia	Torque or force scaling gain value that converts commanded acceleration into equivalent rated torque/force.
Torque Offset	Provides a torque bias when performing closed loop control.
Load Observer Configuration	Configures the operation of the Load Observer.
Load Observer Bandwidth	Determines the proportional gain, Kop, of the load observer.

The Filters tab lets you input torque values.



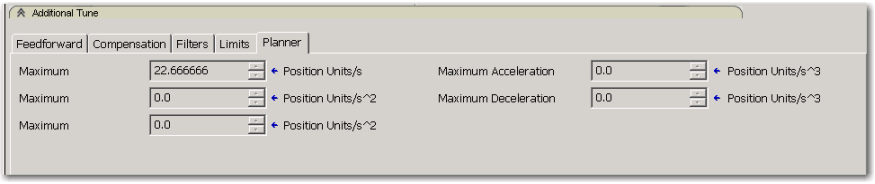
Attribute	Description
Torque Low Pass Filter Bandwidth	Break frequency for the second order low pass filter that is applied to the torque reference signal.
Torque Notch Filter Frequency	Center frequency of the notch filter that is applied to the toque reference signal.

The Limits tab lets you input peak and velocity values.



Attribute	Description
Peak Torque Limit	Floating point that is based on calculations using Max Motor Torque, Max Drive Torque, Motor Peak Current, Motor Rated Current, and Drive Peak Current attributes.
Velocity Limit	Positive or Negative velocity reference value.

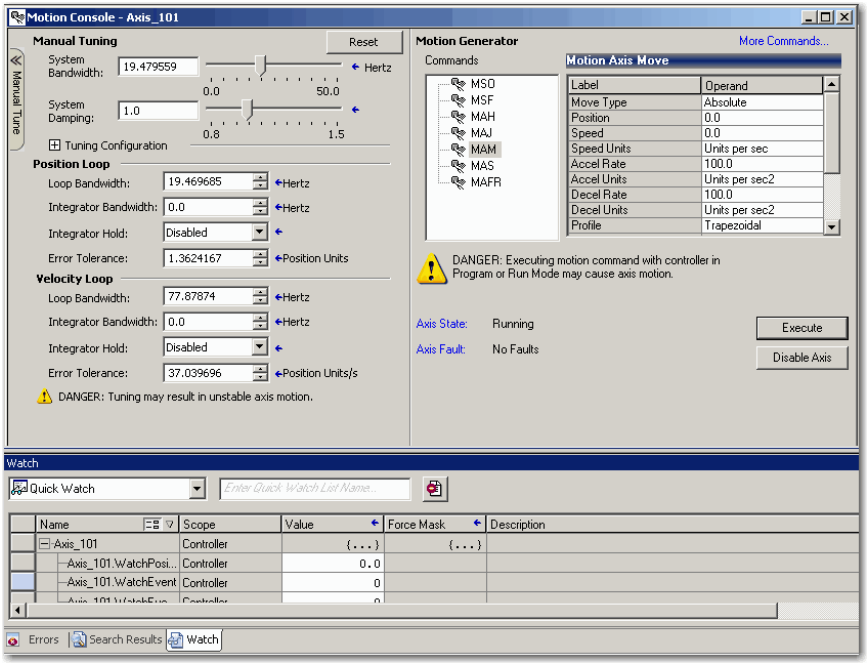
The Planner tab lets you input the maximum values for acceleration and deceleration.



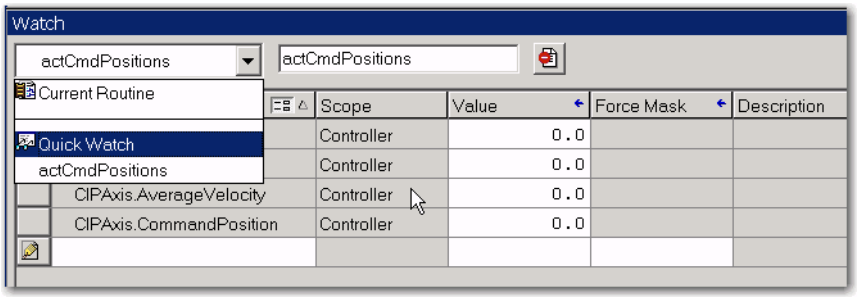
Attribute	Description
Maximum	The value of the Maximum Speed attribute used by various motion instructions to determine the steady-state speed of the axis.
Maximum Acceleration and Maximum Deceleration	The Maximum Acceleration and Maximum Deceleration values frequently used by motion instructions, for example, MAJ, MAM, and MCD, to determine the acceleration/deceleration rate to apply to the axis.

Quick Watch

The Quick Watch window lets you monitor the tags in your program while you are executing commands. To open Quick Watch, press ALT+3 or choose it from the View menu.



You create Quick Watch Lists by choosing Quick Watch from the pull-down menu.



Once you name a Quick Watch List, it available in the ACD, L5K, and L5X files. Make sure to name your lists. Lists that do not have names are lost when you close the software.

Motion Generator

This example assumes the following:

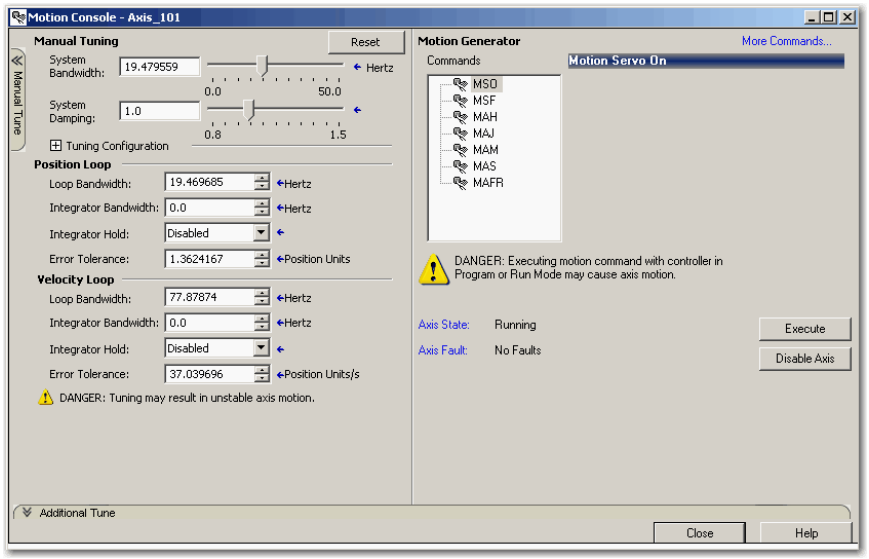
- The servo is off, with session Online
- Axis State: Stopped
- Axis Faults: No Faults

1. Choose MSO (Motion Servo On).

   This readies the drive for motion, and enables the servo loop.

2. Click Execute.

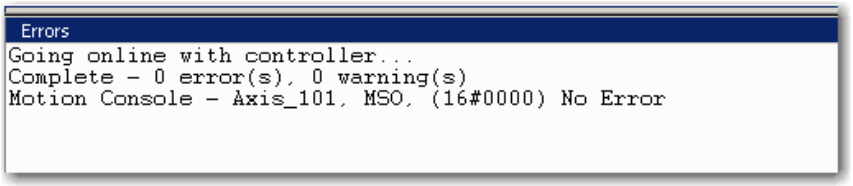
   The axis state goes to Servo = On.



The Motion Console dialog box displays the following:

- Axis State: Running
- Axis Faults: No Faults

The Results window displays the following message.



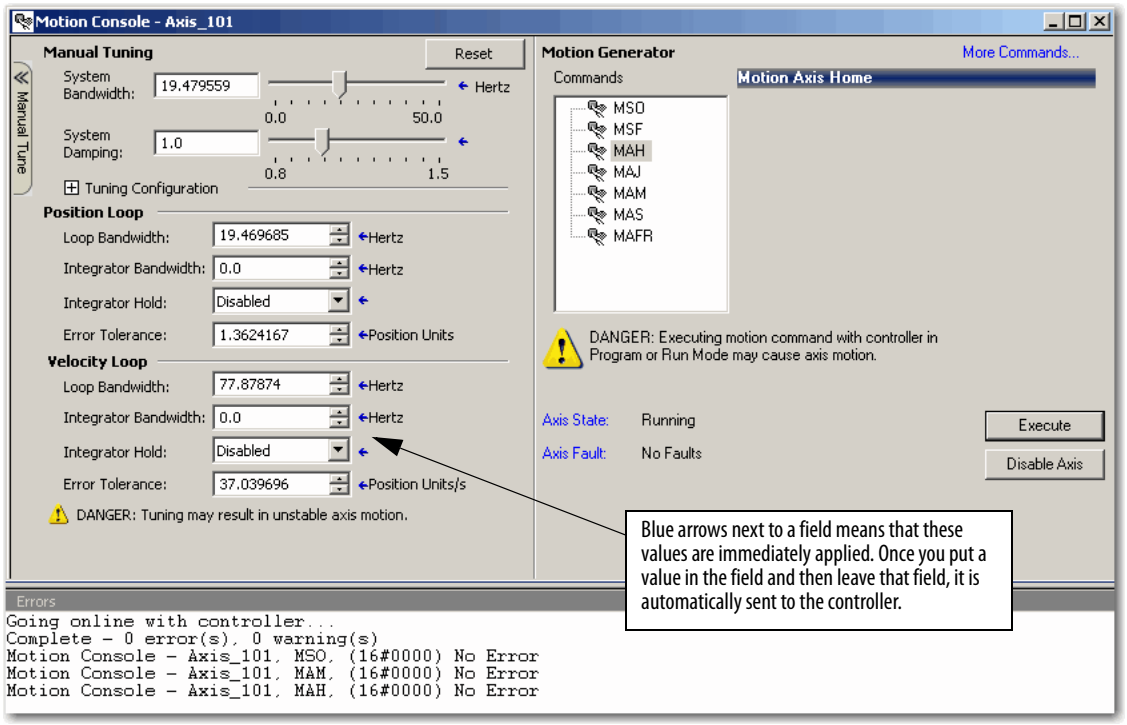
3. Select MAH (Motion Axis Home) and click Execute.

   Use this step to execute the Homing command to establish a feedback positional reference, if a Position loop is being tuned.

The axis state goes Servo-On, and the controller performs the Axis Home procedure, which is based on the configured Home settings.

The Motion Console dialog box appears:

- Axis State: Running
- Axis Faults: No Faults



The Results window displays No Error.

4. Choose MAM (Motion Axis Move).

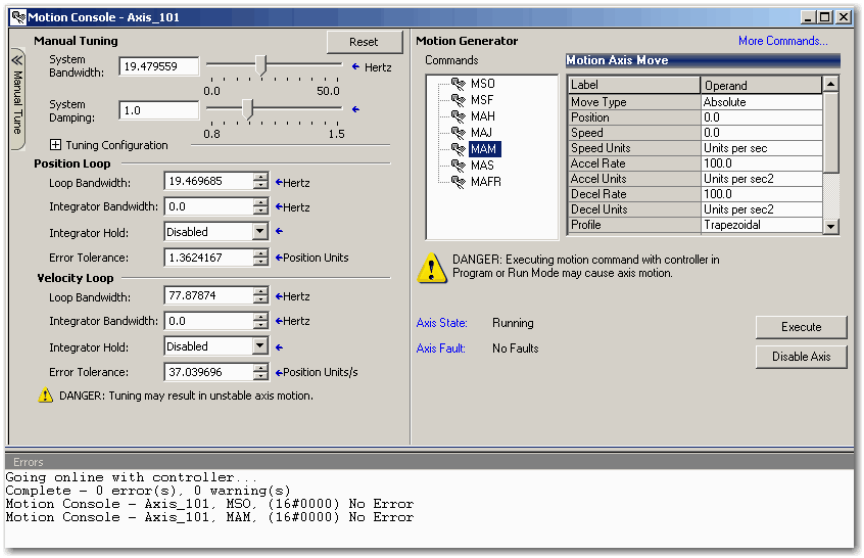
This step initiates an Axis-Move at the selected speed, acceleration/deceleration, profile, and end point position and lets you observe the axis response.

Before executing this MAM Move, you may want to initiate a method to observe the axis response during the move.

Some examples include the following:

- Watch-window:
  Quick Watch tag name = Axis_y.ActualPosition or = Axis_y.ActualVelocity
- New Trend with Tags:
  Axis_y.ActualPosition or = Axis_y.ActualVelocity
- Axis Properties:
  Status dialog box = Axis_y.ActualPosition or = Axis_y.ActualVelocity

5. Click Execute.



The controller performs a controlled axis move.

The Motion Console dialog box appears:

- Axis State: Running
- Axis Faults: No Faults

The Results window displays No Error.

6. Observe and verify the Axis response.

The axis motion moves according to the configured MAM settings:

– If the settings and response are satisfactory, then tuning is finished and you can close Manual Tune.

– If the settings or response are not satisfactory, stay in Manual Tune and adjust the parameters.

Also useful for diagnostics purposes are the hyperlinks to Axis State and Axis Fault.

– Axis State goes to the Status dialog box of the Axis Properties.

– Axis Faults is a hyperlink to Faults and Alarms dialog box of Axis Properties.

Faults and Alarms

There are four ways to find and view faults and alarms:

- Fault and Alarm Log
- QuickView Pane
- Tag Monitor, see the individual fault-related attributes
- Drive Status Indicators

Topic	Page
Troubleshoot Faults	214
Manage Motion Faults	215
Configure the Exception Actions for AXIS_CIP_DRIVE	216
Inhibit an Axis	219

Faults and Alarms Dialog Box

The Faults and Alarms dialog box displays the status of faults and alarms in the controller for an axis. The display is read-only except for the ability to clear logs. Fault and alarm entries are displayed only when you are online with a controller.

When online, check or clear the checkboxes in the Show row to toggle between showing and hiding the specified group of entries. The last 25 faults and alarms only display.

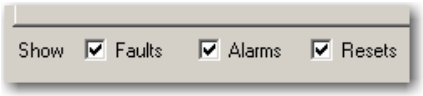
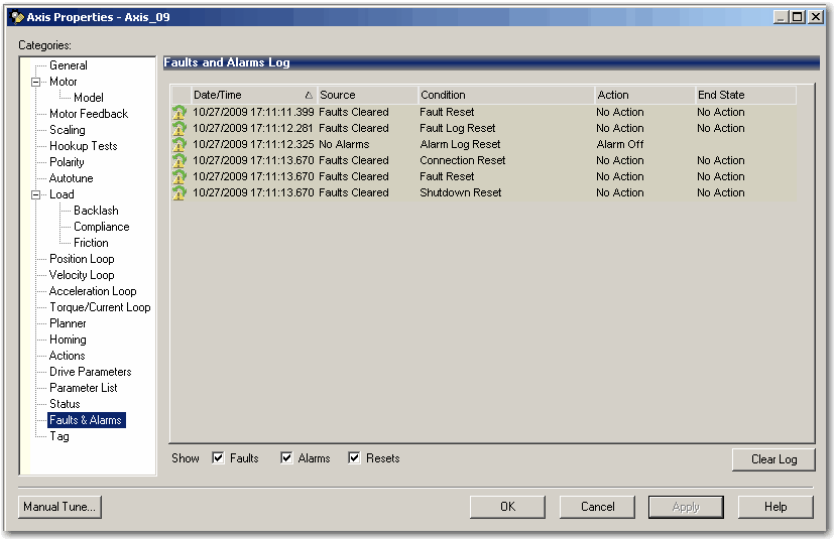


Figure 6 - Faults and Alarms Log



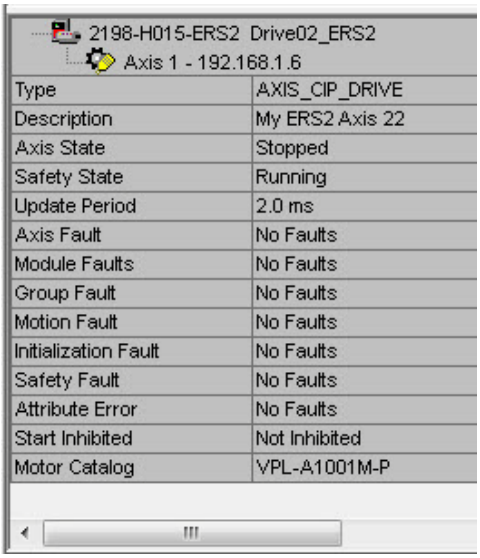
This table describes the parameters for the Faults and Alarms dialog box.

Table 28 - Faults and Alarms Dialog Box Descriptions

Parameter	Description
Indicator	Displays the following icons to indicate the state of a fault or alarm: • Alarm On • Alarm Off • Fault Occurred • Reset Occurred
Date/Time	Displays the date and time the event occurred. The time stamp is the workstation setting.
Source	Displays the source of the event, for example: • Safety Fault • Module Fault • Group Fault • Axis Fault • Axis Alarm
Condition	Displays detailed information specific to the event category and code. For drive exception conditions, the information is the same text used for the condition. This field can contain more information when the Subcode field has been used for that entry and is a more detailed entry if both codes are used in the log, for example: • Group Sync Failure • Bus Overvoltage UL • All Axis Faults • Motor Overspeed • Axis Init Fault
Action	Displays the action command that was executed in response to the event as configured in the axis. For instance, in many cases this indicates that a command sent to a drive, for example: • Planned Stop • Ramped Stop • Limited Stop • Coast • No Action • Alarm Off • Alarm On
End State	Displays the action result that is returned from the axis, which can be more detailed than the command sent. For instance, a send of Disable Drive can result in either Holding, Shutdown or other status, for example: • Stopped - Hold • Stopped - Disable • Shutdown • Shutdown Reset
Faults	Toggles between faults; display or hide.
Alarms	Toggles between alarms; display or hide.
Clear Log	Clears both the fault and alarm logs in the controller for this axis.

QuickView Pane

The QuickView pane gives you a quick summary of faults and alarms that are related to the axis you select in the Controller Organizer. The information includes the type of axis, description, axis state, faults, and alarms.

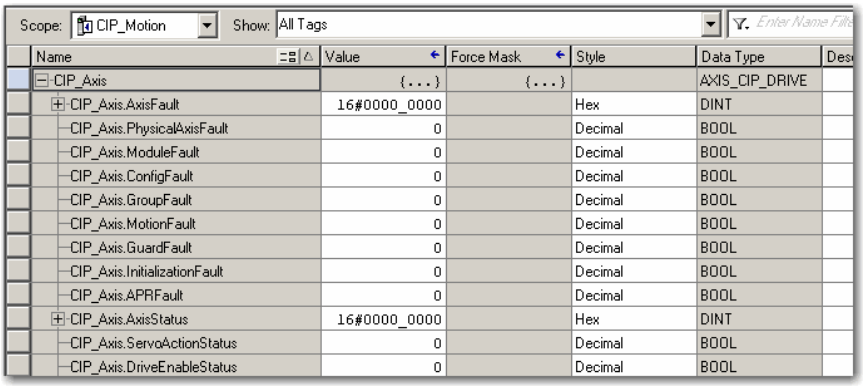


Data Monitor

The Data Monitor is where you can read and write the values that are assigned to specific tags, both online and offline.

You can do the following:

- Set a tag description.
- Change the display style of a value.
- Change a force mask value.
- Sort your tags alphabetically.



Drive Status Indicators

For complete information on drive status indicators, see the following publications:

Kinetix 6500 drive

- Kinetix 6500 Control Modules Installation Instructions, publication 2094-IN014
- Kinetix 6000 Multi-Axis Drive User Manual, publication 2094-UM001

Kinetix 350 drive

- Kinetix 350 Single-axis EtherNet/IP Servo Drives User Manual, publication 2097-UM002

Kinetix 5500 drive

- Kinetix 5500 Servo Drives User Manual, publication 2198-UM001

Kinetix 5700 drive

- Kinetix 5700 User Manual, publication 2198-UM002

PowerFlex 755 drive

- PowerFlex 755 Drive Embedded EtherNet/IP Adapter Installation Instructions, publication 750-IN001
- PowerFlex 755 Drive Embedded EtherNet/IP Adapter User Manual, publication 750COM-UM001
- PowerFlex 750-Series AC Drives, publication 750-PM001

Troubleshoot Faults

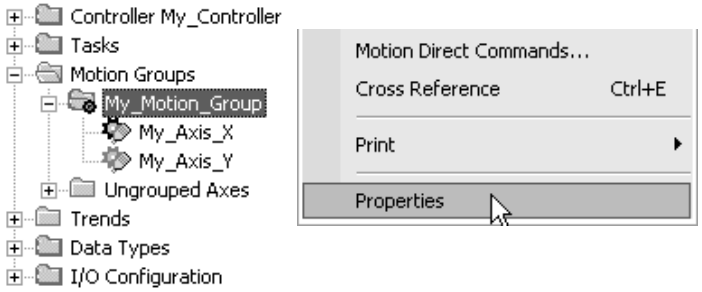
The controller has these types of motion faults.

Type	Description	Example
Instruction error	Caused by a motion instruction: • Instruction errors do not impact controller operation. • Review the error code in the motion control tag to see why an instruction has an error. • Fix instruction errors to optimize execution time and make sure that your code is accurate. See Error Codes (ERR) for Motion Instructions, publication MOTION-RM002.	A Motion Axis Move (MAM) instruction with a parameter out of range.
Fault	Caused by an anomaly with the servo loop: • You choose whether motion faults give the controller major faults. • Can shut down the controller if you do not correct the fault condition.	• Loss of feedback. • Actual position that exceeds an overtravel limit.

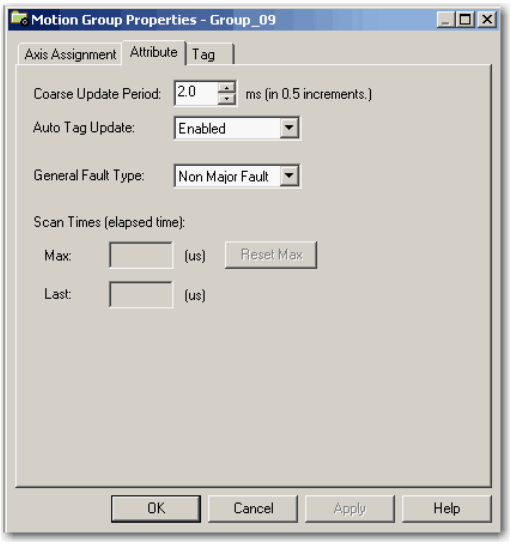
Manage Motion Faults

By default, the controller runs when there is a motion fault. As an option, you can have motion faults cause a major fault and shut down the controller.

1. Choose a General Fault Type.
2. Do you want any motion fault to cause a major fault and shut down the controller?
   - YES - Choose Major Fault.
   - NO - Choose Non-Major Fault. You must write code to handle motion faults.
3. Right-click Motion Group and choose Properties.



4. Click the Attribute tab.
5. From the General Fault Type pull-down menu, choose the general fault type.



Configure the Exception Actions for AXIS_CIP_DRIVE

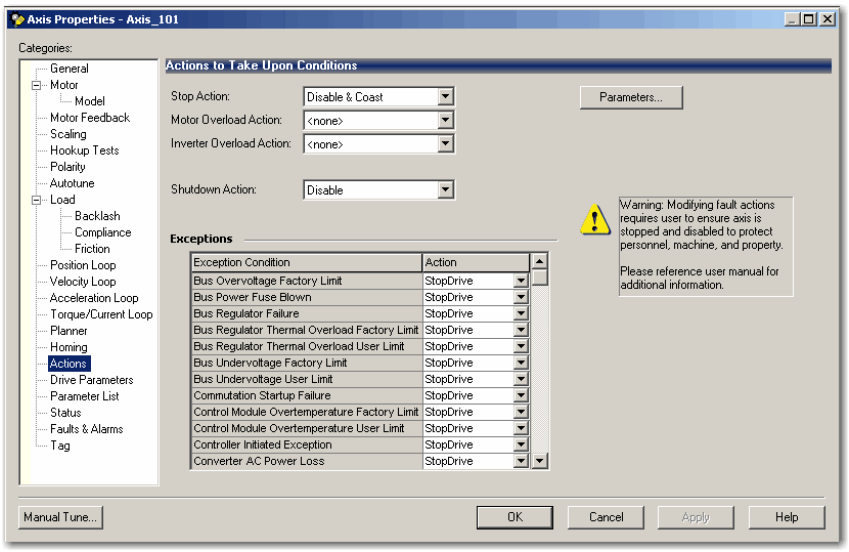
Use exception actions to set how an axis responds to different types of faults. The types of faults depend on the type of axis and how you configure it.

TIP If you have used sercos motion, these are called fault actions.

The available actions for each Exception are controlled by the drive the axis is associated with. When a fault or alarm occurs, the corresponding fault or alarm axis attributes are set.

See Exception, Fault, and Alarm Attributes in the Integrated Motion on the EtherNet/IP Network Reference Manual, publication MOTION-RM003.

Open the Axis Properties Actions dialog box for an axis to configure the Exception Actions.



Options for each of the actions and the list of Exceptions may change based on how you configure the drive. If an exception is not possible for a specific drive (as defined by the profile of the drive), then that exception is not shown in this list.

The list of actions that are taken can be restricted by the drive. When a previously selected entry is no longer supported due to a configuration change, most of the entries default to Stop Drive. In the few cases where Stop Drive does not apply, the default is Fault Status Only. For example, Stop Drive does not apply with a Feedback Only type configuration.

Figure 7 - Action Parameter Group Dialog Box

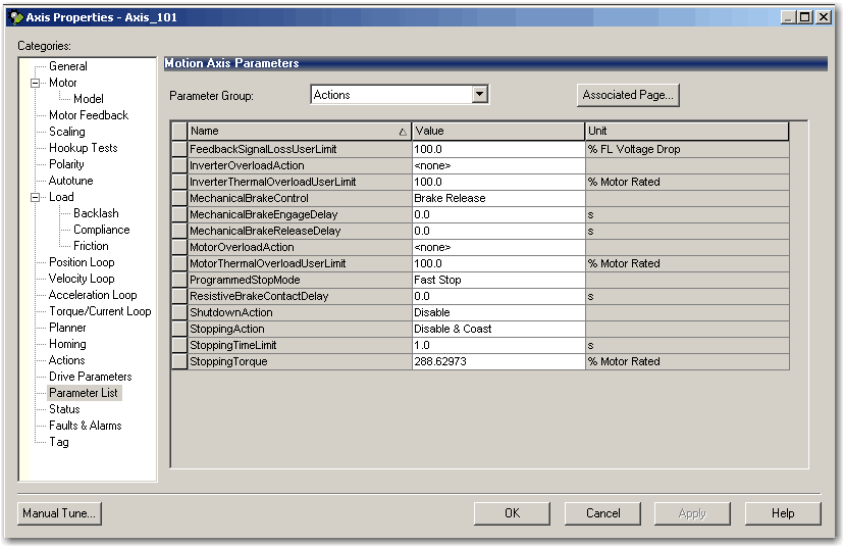


Table 29 - Action Tasks and Related Faults

Task	Choose	Description
Shut down the axis and let it coast to a stop.	Shutdown	Shutdown is the most severe action. Use it for faults that could endanger the machine or the operator if you don't remove power quickly and completely. A fault happens when the following occurs: • Axis servo action is disabled • Servo amplifier output is zeroed • Appropriate drive enable output is deactivated • OK contact of the servo module opens. Use this to open the E-Stop string to the drive power supply
Stop the axis and let the drive stop the axis where you use the Stopping Action attribute to configure how to stop the drive.	Stop Drive	A fault happens when the following occurs: • Axis servo action is disabled • Servo amplifier output is zeroed • Appropriate drive enable output is deactivated • Drive switches to local servo loop control and the axis is slowed to a stop using the Stopping Torque • The servo action and the power structure are disabled if the axis doesn't stop in the Stopping Time

Table 29 - Action Tasks and Related Faults

Task	Choose	Description
Leave the servo loop on and stop the axis at its Maximum Deceleration rate.	Stop Planner	Use this fault action for less severe faults. It is the gentlest way to stop. Once the axis stops, you must clear the fault before you can move the axis. The exception is Hardware Overtravel and Software Overtravel faults, where you can jog or move the axis off the limit.
		A fault happens when the following occurs: • Axis slows to a stop at the Maximum Deceleration Rate without disabling servo action or the servo module Drive Enable output • Control of the drive's servo loop is maintained • Axis slows to a stop at the Maximum Deceleration rate without disabling the drive
Write your own application code to handle the fault.	Fault Status Only	Use this fault action only when the standard fault actions are not appropriate. With this fault action, you must write code to handle the motion faults. For Stop Motion or Status Only, the drive must stay enabled for the controller to continue to control the axis. Selecting Status Only lets motion continue only if the drive itself is still enabled and tracking the command reference.
	Ignore	Ignore instructs the device to completely ignore the exception condition. For some exceptions that are fundamental to the operation of the axis, it may not be possible to Ignore the condition.
	Alarm	Alarm action instructs the device to set the associated bit in the Axis Alarm word, but to otherwise not affect axis behavior. For some exceptions that are fundamental to the operation of the device, it may not be possible to select this action or any other action that leaves device operation unaffected.

Inhibit an Axis

Follow these instructions to determine when to inhibit an axis and how to block the controller from using an axis.

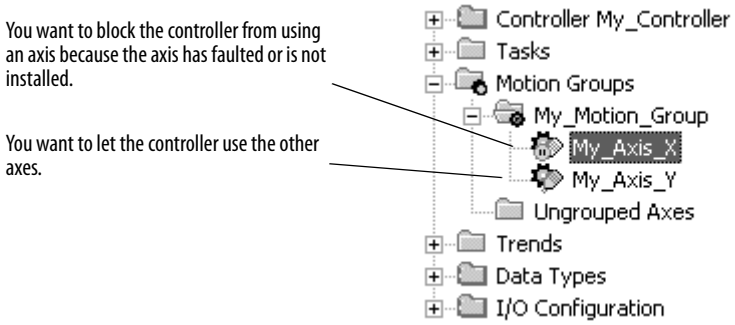
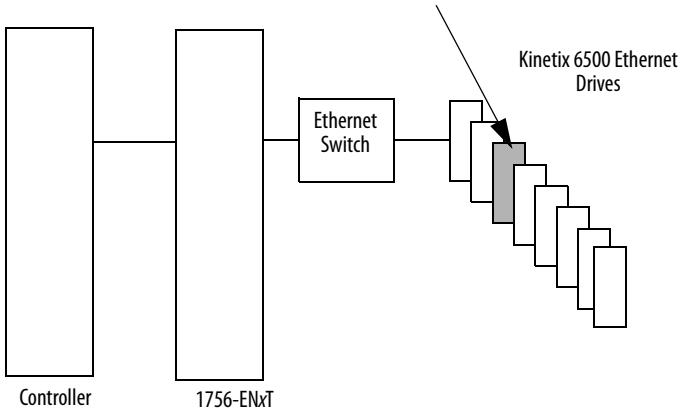
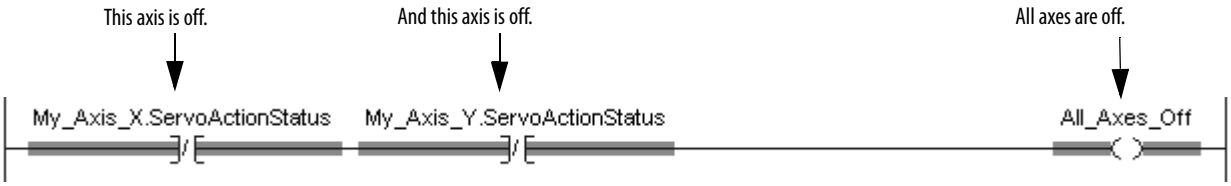


Table 30 - Inhibit Axes

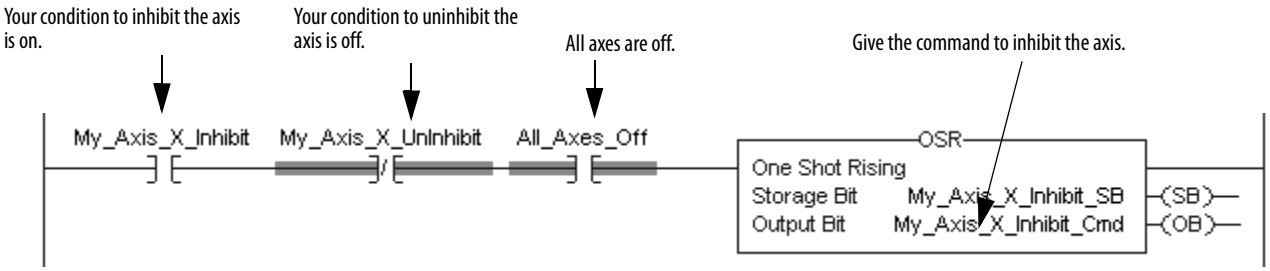
Before you inhibit or uninhibit an axis, turn off all axes.	Before you inhibit or uninhibit an axis, be aware that inhibit/uninhibit of an axis will also affect any half axes in the same drive. 1. Stop all motion in the axis. 2. Use an instruction such as the Motion Servo Off (MSF) for the axis. This lets you stop motion under your control. Otherwise the axes turn off on their own when you inhibit or uninhibit one of them. CIP only connections to the drive with the affected axis are shut down. Connections and motion on all other drives axes continue uninterrupted.  The controller automatically restarts the connections.
To inhibit the axes, inhibit the communication module.	Do you want to inhibit the Integrated Motion on the EtherNet/IP network axes? • YES—Inhibit the 1756-ENxT communication modules. • NO—Inhibit the individual axes. You can inhibit the axes of a module on an individual basis. However, it is more efficient to inhibit all axes at once by inhibiting the module. **Important**: If you inhibit an axis on a drive, you inhibit all action on the drive, including any half axes. Make sure that you are aware of all action on a drive before inhibiting the axis.

Example: Inhibit an Axis

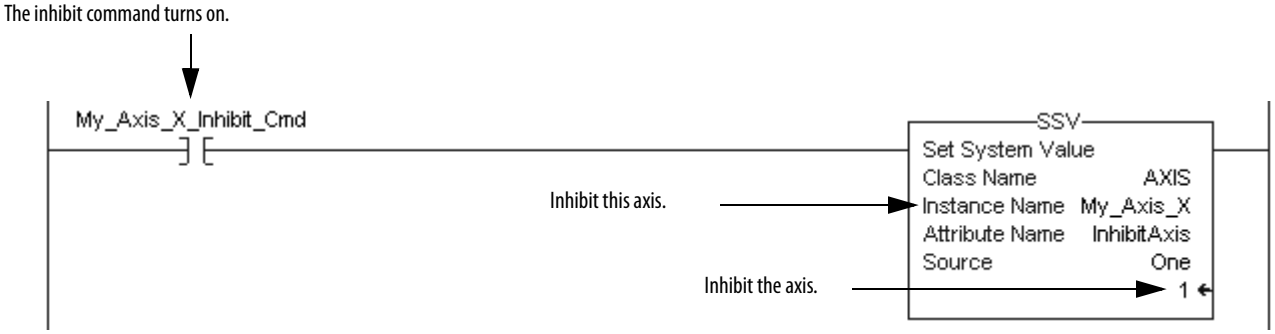
1. **Make sure all axes are off.**



2. **Use a one-shot instruction to trigger the inhibit.**



3. **Inhibit the axis.**



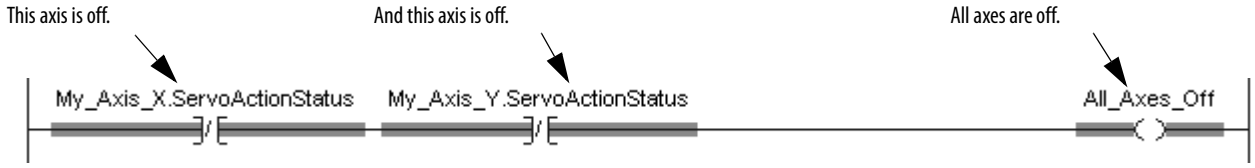
4. **Wait for the inhibit process to finish.**

   All of these have happened:

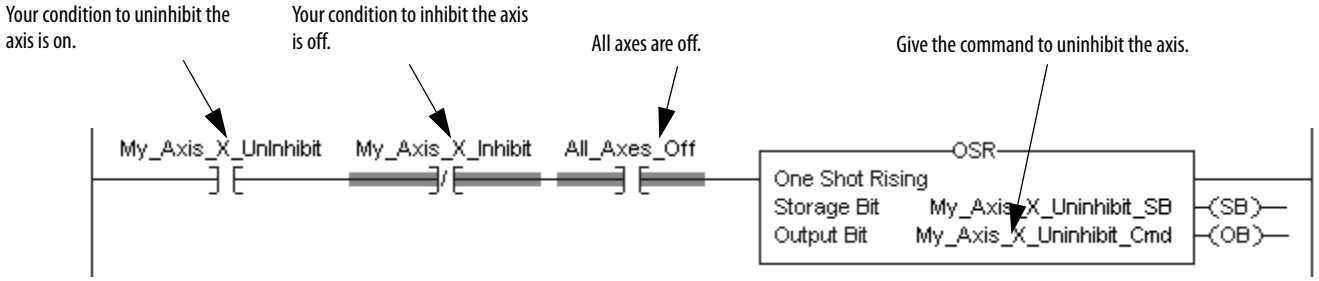
   - The axis is inhibited.
   - All uninhibited axes are ready.
   - The connections to the motion drive module are running again.

Example: Uninhibit an Axis

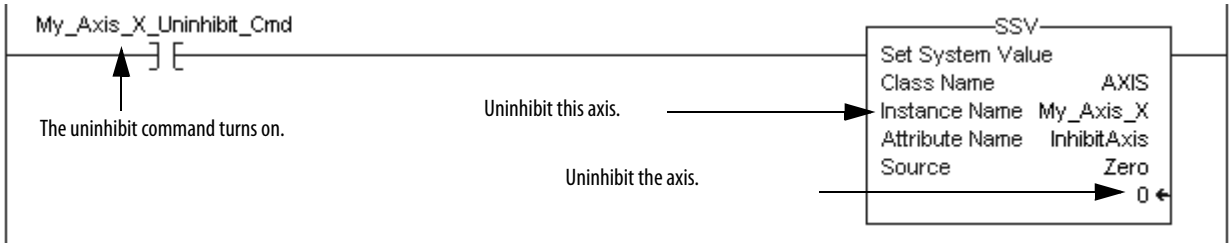
1. Make sure all axes are off.



2. **Use a one-shot instruction to trigger the uninhibit.**



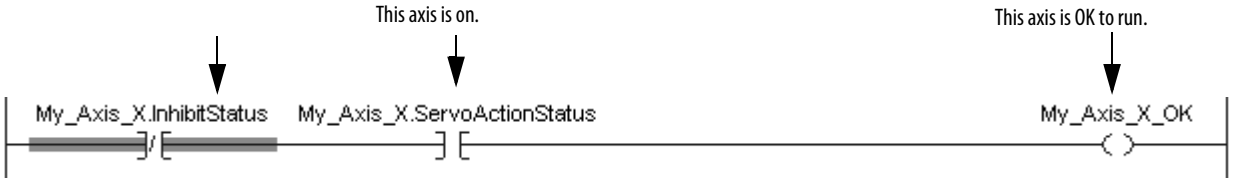
3. **Uninhibit the axis.**



4. **Wait for the inhibit process to finish.**

All of these have happened:

- The axis is uninhibited.
- All uninhibited axes are ready.
- The connections to the motion drive module are running again.



Notes:

CIP Drive Module Properties

Use this appendix for a description of each tab of the CIP drive Module Properties dialog box.

Topic	Page
General Tab	224
Connection Tab	226
Safety Tab	227
Time Sync Tab	228
Module Info Tab	229
Internet Protocol Tab	231
Port Configuration Tab	233
Network Tab	237
Associated Axes Tab	240
Power Tab	244
Digital Input Tab	247
Motion Diagnostics Tab	248

Module Properties

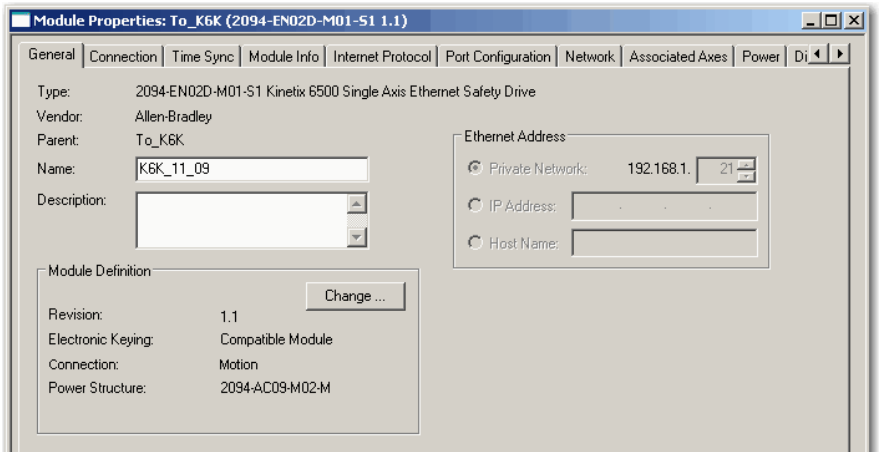
The Module Properties dialog boxes provide the configuration information that you use to configure your CIP drive module. For all tabs, when you click Apply, the software accepts and applies your edits and you can continue configuring your module. When you are online, the information is automatically sent to the controller. The controller tries to send the information to the module, if the connection to the module is not inhibited. These examples show the Kinetix 6500 drive module properties pages. Other module property pages for drives, such as PowerFlex 755, Kinetix 350, and Kinetix 5500 servo drives are noted where appropriate.

General Tab

The General tab provides the internal drive type description, vendor, and the parent 1756-En*x*T communication module. On the General tab, you can do the following:

- Name the drive module.
- Write a description for the drive module.
- Configure the module.

Figure 8 - General Tab



Click Change in the Module Definition area to select the following:

- Revision of the module.
- Electronic Keying type, do not use Disable Keying for motion applications.
- Type of connection, in this case Motion.
- Correct Power Structure that is coupled to the drive module. You can also verify the power rating of the power structure when you go online.

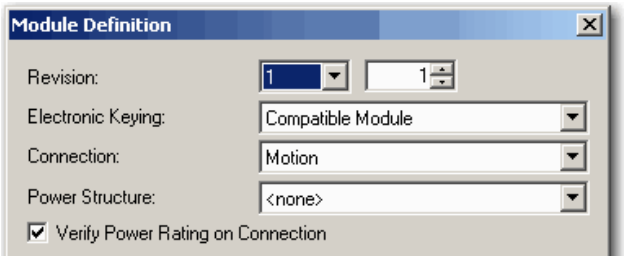


Figure 9 - General Tab

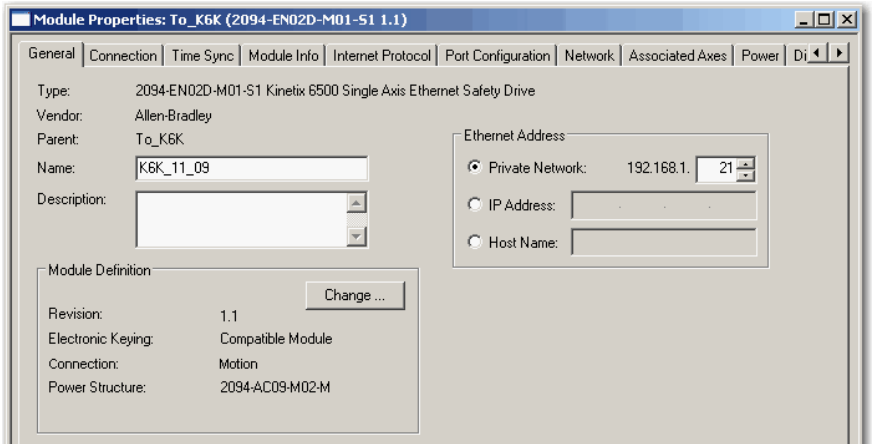


Table 31 - Module Properties: General Tab Parameter Descriptions

Parameter	Description
Revision	Assign the major and minor revision of the drive. The major revision is set automatically and it cannot be changed. If you change the major revision, any axis that is associated with the drive is lost and the module configuration settings are reset to default values. The minor revision is a value from 1…255. It is enabled when Electronic Keying is not set to Disable Keying and the controller is offline, or when the controller is in Remote Run mode. It is not available when the controller is in Run mode.
Electronic Keying	Set the electronic keying as Exact Match or Compatible Module. Never use Disable Keying in motion applications.
Power Structure	Defines the current and voltage of the drive. It is a voltage current duty cycle combination. When you change the power structure, the associated axis settings are removed and the values are reset to defaults.
Power Ratings	Verifies that the power structure in the profile is the same as the connected drive. You can see a power mismatch depending on state of the checkbox. Verify that Power Rating on Connection is checked by default. It is enabled in offline mode. You can access the Verify Power Rating by clicking Change.
Connection	Available offline only. The default and only value is Motion.
Ethernet Address	Assign an Ethernet address for the integrated motion drive. Depending on your application requirements, you can either assign a Private Network Address or a general IP address. You can also assign a Host Name. A Host Name can have up to 64 ASCII characters. Valid values: • 0...9 • A...Z • Upper or lower case letters • - (dash) • . (period) For specific information about configuring the EtherNet/IP network for the Kinetix 6500 control module, see the Kinetix 6200 and Kinetix 6500 Modular Servo Drive User Manual, publication 2094-UM002. For general information about setting IP addresses and other Ethernet network considerations, see the Ethernet User Manual, publication ENET-UM001.

Connection Tab

The Connection tab provides you with information about the connection condition between the controller and a module. The information comes from the controller.

Figure 10 - Connection Tab

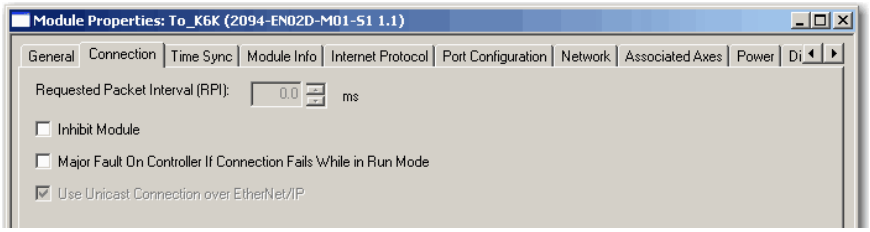


Table 32 - Module Properties: Connections Tab Parameter Descriptions

Parameter	Description
Requested Packet Interval (RPI)	Each controller has its own RPI setting. The Connection tab for each module displays its own value. This is also true for a virtual adapter.
Inhibit Module	Check to inhibit your connection to the module. When you inhibit the module, it causes a disconnection to the module. When you go online, an icon appears on the 2094-EN02D-M01-S1 K_101 module that states that the module is inhibited. **Inhibit Online** If you inhibit the module while you are online and are connected to the module, the connection is closed and the outputs go to the last configured Program mode state. **Inhibit Online but Connection Not Established** If you inhibit the module while online but a connection to the module has not been established, due to an error condition or fault, the module is inhibited. The module status information changes to indicate that the module is Inhibited and not Faulted. **Uninhibit Online** If you uninhibit a module online, and no fault condition occurs, a connection is made to the module, and the module is reconfigured. If you are not the owner and in Listen Only mode, the module is not reconfigured. **Uninhibit Online and a Fault Occurs** If you uninhibit a module while online and a fault condition occurs, a connection is not made to the module.
Major Fault	Configure the controller so that a loss of connection to this module causes a major fault.
Module Faults	Displays the fault code that is returned from the controller and provides details about the fault.

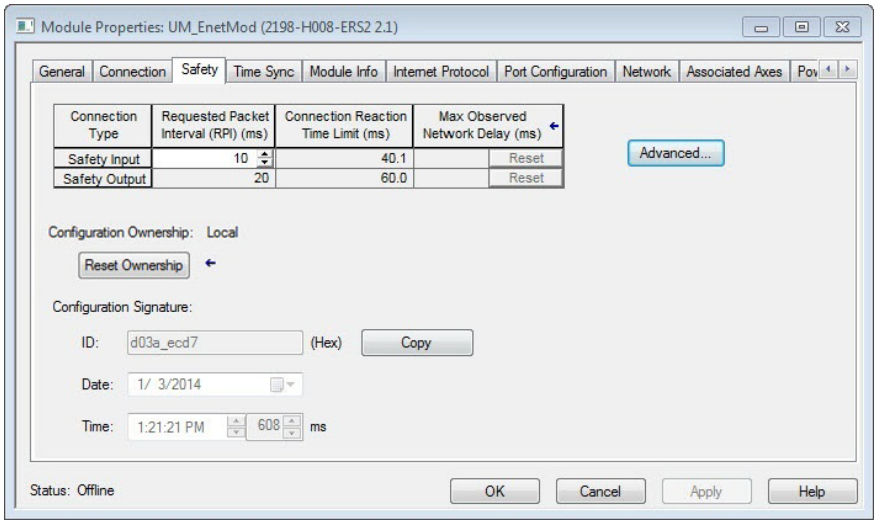
The following table describes common connection errors.

Table 33 - Common Connection Errors

Error	Description
Connection Request Error	The controller is attempting to make a connection to the module and has received an error. The connection was not made.
Service Request Error	The controller is attempting to request a service from the module and has received an error. The service was not performed successfully.
Module Configuration Invalid	The configuration in the module is invalid. Module Configuration Rejected - invalid power structure.
Electronic Keying Mismatch	Electronic Keying is enabled and some part of the keying information differs between the software and the module.

Safety Tab

The Safety tab provides you with information about the connection between the owner and the 2198-H*xxx*-ERS2 servo drive. The information comes from the controller.



The connection between the owner and the 2198-H*xxx*-ERS2 servo drive is based on the following:

- Servo drive catalog number must be 2198-H*xxx*-ERS2 (integrated)
- Servo drive safety network number
- GuardLogix slot number
- GuardLogix safety network number
- Path from the GuardLogix controller to the 2198-H*xxx*-ERS2 drive
- Configuration signature

If any differences are detected, the connection between the GuardLogix controller and the 2198-H*xxx*-ERS2 drive is lost, and the yellow yield icon appears in the controller project tree after you download the program.

For complete information on how to configure a drive with integrated safety connections, see the Kinetix 5500 Servo Drives User Manual, publication 2198-UM001.

Time Sync Tab

When you are online with the controller, you can review the time synchronization status data that is related to the network. When you are offline, no values display.

Figure 11 - Time Sync Tab

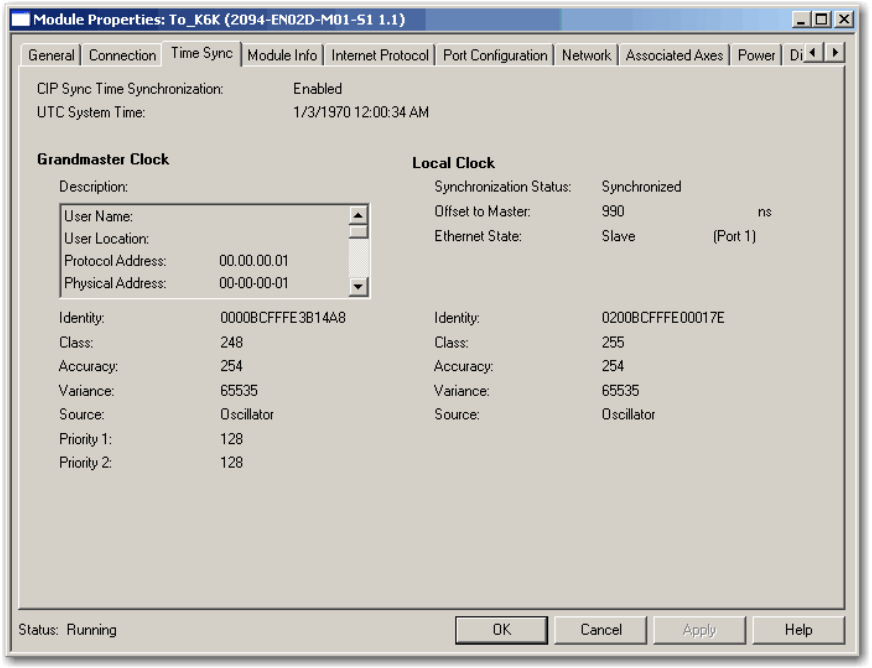


Table 34 - Time Sync Tab Descriptions for the Grandmaster Clock

Parameter	Description
Identity	Specifies the unique identifier for the Grandmaster clock. The format depends on the network protocol. Ethernet network encodes the MAC address into the identifier while ControlNet and DeviceNet networks encode the vendor ID and serial number into the identifier.
Class	Specifies a measure of the quality of the Grandmaster clock. Values are defined from 0 . . . 255 with zero as the best clock.
Accuracy	Indicates the expected absolute accuracy of the Grandmaster clock relative to the PTP epoch. The accuracy is specified as a graduated scale that starts at 25 ns and ends at greater than 10 seconds or unknown. The lower the accuracy value, the better the clock.
Variance	Displays the measure of inherent stability properties of the local clock. The value is in offset scaled log units. The lower the variance, the better the clock.
Source	Specifies the time source of the Grandmaster clock (for example, GPS, NTP, and hand). Priority1/Priority 2 specifies the relative priority of the Grandmaster clock to other clocks in the system. These fields can be used to override the best master in the system.

Table 35 - Time Sync Tab Descriptions for the Local Clock

Parameter	Description
Local Clock	Specifies clock property information for the local clock. The Local Clock values appear dimmed in offline mode or when PTP is disabled.
Synchronization Status	Specifies whether the local clock is synchronized with the Grandmaster reference clock. The value is 1 if the local clock is synchronized and zero if the local clock is not synchronized. A clock is synchronized if it has one port in the slave state and is receiving updates from the time master.
Offset Master	Specifies the amount of deviation between the local clock and the Grandmaster clock in nanoseconds.
Backplane State	Specifies the state of the backplane.
Ethernet State	Specifies the state of the Ethernet port.

- For more information about the Time Sync tab, see Set Time Synchronization on page 92.
- For detailed information about CIP Sync, see the Integrated Architecture and CIP Sync Configuration Application Technique, publication IA-AT003.

Module Info Tab

The Module Info Tab displays module and status information. You can also reset a module to the power-up state. Use this tab to determine the identity of the module. The data on this tab comes directly from the module. If you selected a Listen-Only communication format when you created the module, this tab is not available. You cannot see any values if you are offline or you are creating a module.

When you are online with the controller, you can review real time drive status information. When you are offline, no values display.

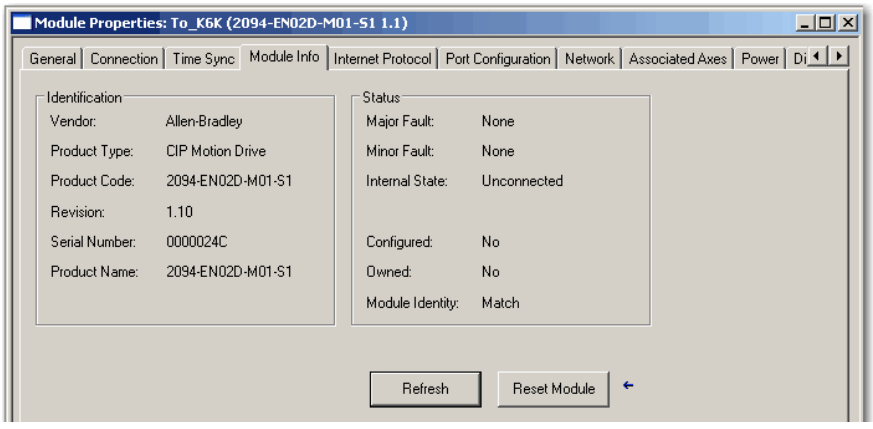


Table 36 - Module Properties: Module Info Tab Descriptions

Category	Parameter	Description
Identification	Vendor	Manufacturer of the module.
	Product Type	Type of module.
	Product Code	Usually the same as the name.
	Revision	Firmware revision of the module.
	Serial Number	Serial number of the module.
	Product Name	This value comes from the module. It relates to the Kinetix 6500 drive that you configured as part of your network.
Status	Major Fault	Unrecoverable.
	Minor Fault	Recoverable.
	Internal State	Current operational state.
	Configured	Displays a yes or no value that indicates whether the module is configured by an owner controller who is connected to it. Once you configure a module, it stays configured until you reset, cycle power, or if the owner drops connection to the module.
	Owned	Displays a yes or no value that indicates whether an owner controller is connected to the module.
	Module Identity	**Match** For the display to Match, the following must agree: • Vendor • Module Type, the combination of Product Type and Product Code for a particular Vendor • Major Revision • Mismatch The values that are returned from the module do not match what appears in the General tab. This field does not take into account the Electronic Keying or Minor Revision selections for the module that were specified on the General tab.
Refresh	Gathers updated data from the module.	
Reset Module	• Resets a module to the power-up state by emulating a power cycle. • A module reset causes all connections to or through the module to be closed, and this can result in loss of control.	

Internet Protocol Tab

The Internet Protocol tab lets you configure EtherNet/IP settings. You must be online to configure EtherNet/IP settings. These settings appear dimmed when you are offline. They also appear dimmed when you are online and there is a module mismatch or a communication error occurs. BOOTP or DHCP is not supported.

If you use the switches on the module to set the EtherNet/IP address, the IP is set automatically. If the module does not support setting the IP address via switches, this option does not display.

You can disable IP settings set by switches on the module. Change the switch settings on the module and then reset the module either by cycling power to the module or by clicking Reset on the Module Info tab.

Figure 12 - Internet Protocol

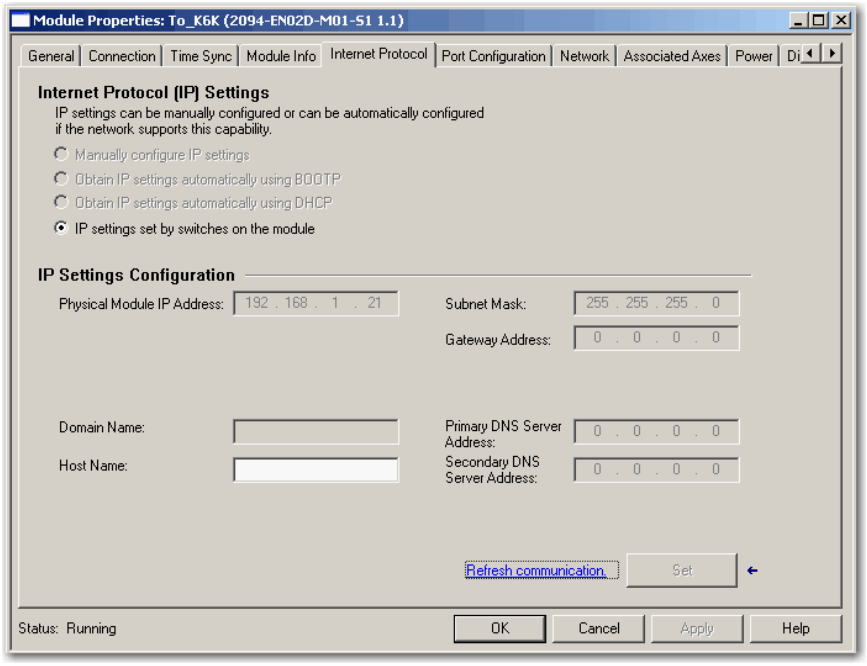


Table 37 - Module Properties: Internet Protocol Tab Descriptions

Parameter	Description
Physical Module IP Address	Displays physical IP address of the module or, if you selected to configure the IP settings manually, enter a valid physical module IP address. See the IP address for valid values. • The Physical Module IP Address appears dimmed and has no value when you are offline or online with a module mismatch or a communication error occurs. • The Physical Module IP Address also appears dimmed when you set the IP address by using the switches on the module. Both a warning message and the IP address that is entered on the General tab appear when you enter a physical module IP address that does not match the IP address that is entered on the General tab. The warning message does not display when you are offline or online and a module mismatch or communication error occurs. You can click Copy IP address from the General tab so that the Physical Module IP Address matches the IP address on the General tab. It appears only when you choose to configure the IP settings manually and when there is a mismatch between the IP address in the physical module and the IP address entered on the General tab.
Subnet Mask	Displays the subnet mask of the module or, if you selected to configure the IP settings manually, enter a valid subnet mask. • The Subnet Mask appears dimmed and is blank when you are offline or online and a module mismatch or communication error occurs. • The Subnet Mask appears dimmed when the module supports the option to set the IP address by using the switches and you choose to set the IP address using the switches.
Gateway Address	Displays the gateway IP address of the module or, if you selected to configure the IP settings manually, enter a valid gateway address. • The Gateway Address appears dimmed and is blank when you are offline or online and a module mismatch or communication error occurs. • The Gateway Address appears dimmed when the module supports the option to set the IP address by using the switches and you choose to set the IP address using the switches on the module.
Domain Name	Displays the domain name of the module or to configure the IP settings manually, enter a valid domain name. See Domain Name for valid values for the domain name. • The Domain Name appears only if the module supports a domain name. It appears dimmed and is blank when you are offline or online and a module mismatch or communication error occurs. • The Domain Name appears dimmed when the module supports the option to set the IP address by using the switches and when you choose to set the IP address by using the switches on the module.
Host Name	Displays the host name of the module or, enter a valid host name. A warning message appears when the host name in the physical module does not match the host name on the General tab. Make sure that the host name entered here matches the host name on the General tab and click Set. The Host Name appears only if the module supports a host name. It appears dimmed and is blank when you are offline or online and a module mismatch or communication error has occurred.
Primary DNS Server Address	Displays the primary DNS server IP address of the module or, if you selected to configure the IP settings manually, enter a valid primary DNS server address. • The Primary DNS Server Address appears only if the module supports a primary DNS server address. It appears dimmed and is blank when you are offline or online and a module mismatch or communication error occurs. • The Primary DNS Server Address appears dimmed when the module supports the option to set the IP address by using the switches that you choose to set the IP address by using the switches on the module.

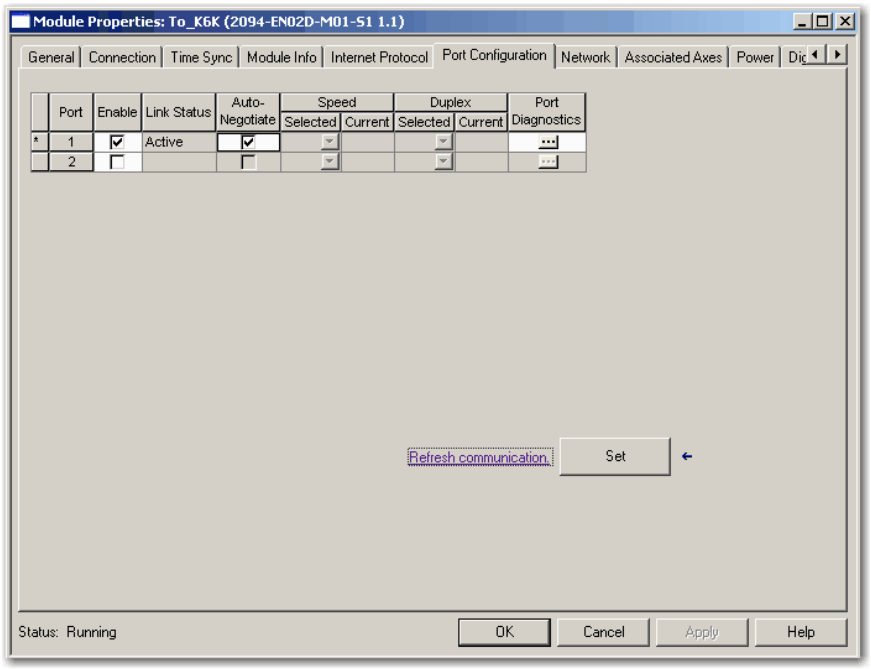
Table 37 - Module Properties: Internet Protocol Tab Descriptions

Parameter	Description
Secondary DNS Server Address	Displays the secondary DNS server IP address of the module or, if you selected to configure the IP settings manually, enter a valid secondary DNS server address. The Secondary DNS Server Address appears only if the module supports a secondary DNS server address. It appears dimmed and is blank when you are offline online and a module mismatch or communication error occurs. The Secondary DNS Server Address appears dimmed when the module supports the option to set the IP address by using the switches on the module you choose to set the IP address by using the switches.
Refresh Communication	Appears when communication with the module has failed. Click Refresh communication to attempt to refresh communication.
Set	Commits modifications to the module. Set appears dimmed when you are offline or online and a module mismatch or communication error has occurred.

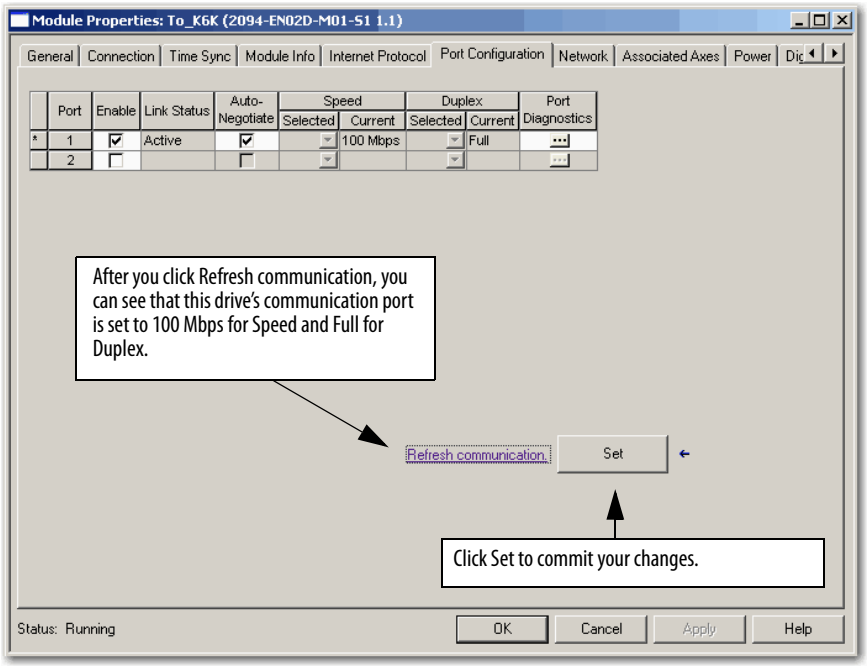
Port Configuration Tab

By enabling Auto-negotiate, the communication between communication modules and drives is automatic.

Figure 13 - Auto-Negotiate Enabled



Notice in Figure 13 on page 233 that you cannot see the current Speed or Duplex. You must click Refresh communication to have those fields populate after you select Auto-Negotiate.



IMPORTANT You must reset the drive to use the new settings. When you reset the drive, it causes a loss of connection and motion stops. The drive is in the STOPPED state.

If you click ... Port Diagnostics you see the values for the Interface and Media Counters.

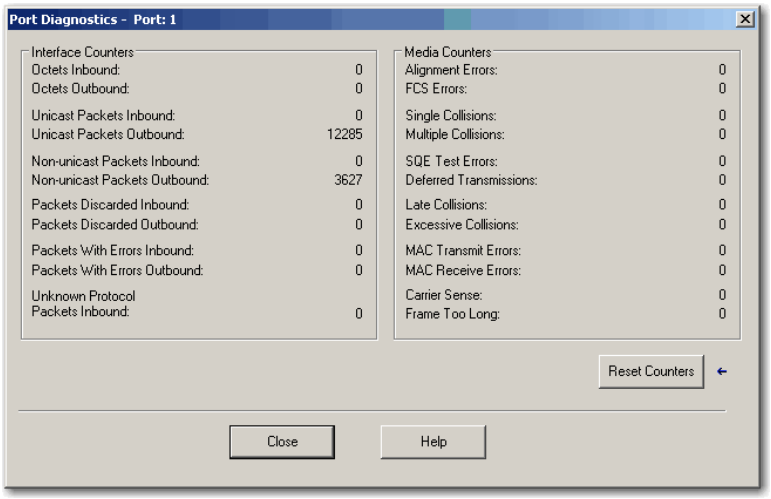


Table 38 - Module Properties: Port Configuration Tab Descriptions

Parameter	Description
Port	Port name.
Enable	Enabled state of the port or check to enable the port. Enable appears dimmed when you are offline or online and a module mismatch or communication error has occurred.
Link Status	Displays the link status as Inactive (port is inactive) or Active (port is active). Link Status appears dimmed when you are offline or online and a module mismatch or communication error has occurred.
Auto-Negotiate	Displays the port's auto-negotiate status. • Check Auto-Negotiate to enable the module to negotiate the port's speed and duplex automatically. • Clear the Auto-Negotiate checkbox to set the port's speed and duplex manually. • Auto-Negotiate appears dimmed and checked when the module's port and duplex cannot be specified manually. • Auto-Negotiate appears dimmed and unchecked when the port's speed and duplex are specified by the module. Auto-Negotiate is unchecked and appears dimmed when you are offline, online and Enable is unchecked, or online and a module mismatch or communication error has occurred.
Selected Speed	Displays the port's selected speed if Auto-Negotiate is unchecked. You can also select the port's speed. Valid speeds: • 10 Mbps • 100 Mbps • 1000 Mbps Selected Speed appears dimmed and has no value if either of the following occurs: • You are offline • Online and Enable is unchecked • Online and Auto-Negotiate is checked • Online and Auto-Negotiate appears dimmed • Online and a module mismatch or communication error has occurred
Current Speed	Displays the port's current speed. Current Speed has no value when you are offline, online and Enable is unchecked, online and a module mismatch, or communication error has occurred.
Selected Duplex	Displays the port's selected duplex if Auto-Negotiate is unchecked. You can select the port's duplex. Valid duplexes are Half and Full. Selected Duplex appears dimmed and has no value if either of the following occurs: • You are offline or online and Enable is unchecked • Online and Auto-Negotiate is checked • Online and Auto-Negotiate appears dimmed • Online and a module mismatch or communication error has occurred
Current Duplex	Displays the port's current duplex. Current Duplex is blank when you are offline, online and Enable is unchecked, online and a module mismatch, or communication error has occurred.
Port Diagnostics	Port Diagnostics appears dimmed when you are offline, online and Enable is unchecked, online and a module mismatch, or communication error has occurred.

Table 38 - Module Properties: Port Configuration Tab Descriptions

Parameter	Description
Reset Module	A reset module message appears stating that the module needs to be reset before the modifications take effect. After you make modifications to either: • Auto-Negotiate state • Selected Speed • Selected Duplex configuration values Clicking Reset Module initiates a reset operation on the module, which returns the module to its power-up state by emulating the cycling of power.
Refresh Communication	Appears when communication with the module has failed. When you click Refresh communication, an attempt is made to refresh communication with the module.
Set	Commits your modifications. Set appears dimmed when you are offline or online and a module mismatch or communication error has occurred or there are no pending edits on the tab.
Apply	Accepts and applies your edits on any tab and you can continue configuring. When you click Apply or OK, the information is automatically sent to the controller. The controller tries to send the information to the module, if the module's connection is not inhibited.

Network Tab

The Network tab provides you the network information for the port.

TIP The Network tab does not exist on the module properties of the PowerFlex 755 or Kinetix 350 drives.

Figure 14 - Network Tab

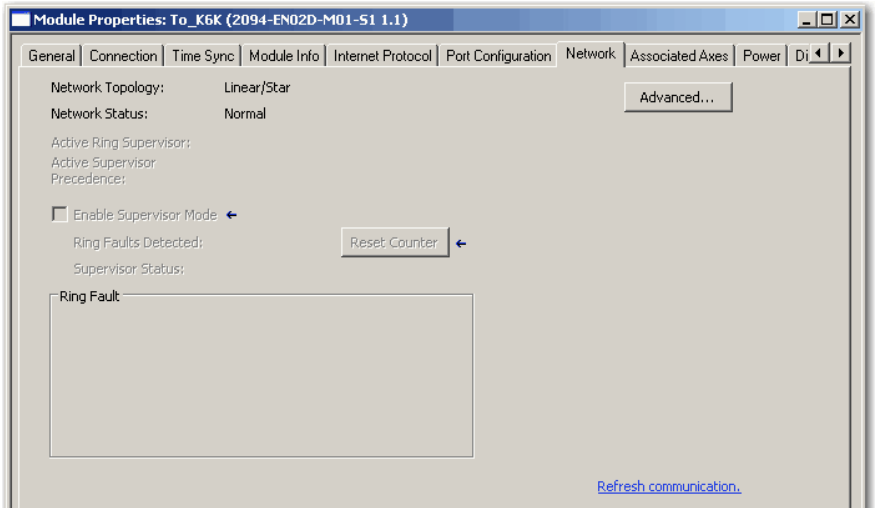


Table 39 - Module Properties: Network Tab Descriptions

Parameter	Description
Network Topology	Displays the current network topology as either Linear/Star or Ring. Network Topology has no value when offline, online and a module mismatch or communication error has occurred.
Network Status	Displays the current network status as either of the following occurs: • Normal • Ring Fault • Unexpected Loop Detected Network Status has no value when offline, online and a module mismatch or communication error has occurred.
Active Ring Supervisor	If the network topology is operating in a Ring mode, it displays the IP Address or MAC Address of the Active Ring Supervisor. Active Ring Supervisor appears dimmed if either of the following: • Offline • Online and a module mismatch or communication error has occurred • The network topology is not operating in a Ring mode
Active Supervisor Precedence	If the network topology is operating in a Ring mode, it displays the Active Ring Supervisor's precedence. Active Supervisor Precedence appears dimmed if either of the following: • Offline • Online and a module mismatch or communication error has occurred • The network topology is not operating in a Ring mode
Enable Supervisor Mode	Displays the Supervisor mode of the module or, checks for the module to be configured as a supervisor on the network. Enable Supervisor mode appears dimmed if either of the following: • Offline • Online and a module mismatch or communication error has occurred

Table 39 - Module Properties: Network Tab Descriptions

Parameter	Description
Ring Faults Detected	When the module is configured as a ring supervisor on the network, it displays the number of times that a ring fault is detected by the Ring. Ring Faults Detected has no value if either of the following occurs: • Offline • Online and a module mismatch or communication error has occurred • The module is not configured as a ring supervisor
Reset Counter	When the module is configured as a ring supervisor on the network, click Reset Counter to reset the ring fault count of the module to zero. Reset Counter appears dimmed if either of the following occurs: • Offline • Online and a module mismatch or communication error has occurred • The module is not configured as a ring supervisor
Supervisor Status	When the module is configured as a ring supervisor on the network, it displays the ring supervisor status of the module as the following: • Active, the module is the Active Ring Supervisor • Back up, the module is the back-up ring supervisor • Cannot support current Beacon Interval or timeout, the module cannot support either the beacon interval or timeout values of the current Active Ring Supervisor Supervisor Status has no value if either of the following occurs: • Offline • Online and a module mismatch or communication error has occurred • The module is not configured as a ring supervisor
Ring Fault	**Last Active Node on Port 1** When the module is the Active Ring Supervisor on the network, it displays the IP Address or MAC Address of the last active node on Port 1 if a ring fault has occurred. Last Active Node on Port 1 is not displayed if either of the following occurs: • Offline • Online and a module mismatch or communication error has occurred • Online and the module is not a ring supervisor • Online and the module is not the Active Ring Supervisor **Last Active Node on Port 2** When the module is the Active Ring Supervisor on the network, it displays the IP Address or MAC Address for the last active node on Port 2 if a ring fault has occurred. Last Active Node on Port 2 is not displayed if either of the following occurs: • Offline • Online and a module mismatch or communication error has occurred • Online and the module is not configured as a ring supervisor • Online and the module is not the Active Ring Supervisor
Verify Fault Location	Verify Fault Location causes the active ring supervisor to verify the last node fault location on port 1 and port 2 of the module. The last fault location that has occurred continues to display until you verify the fault. Verify Fault Location is not displayed if either of the following occurs: • Offline • Online and a module mismatch or communication error has occurred • Online and the module is not configured as a ring supervisor • Online and the module is not the Active Ring Supervisor
Status	When the module is the Active Ring Supervisor on the network, Status displays the ring fault condition on the network as either of the following occurs: • Partial Network Fault • Rapid Fault/Restore Cycles Status is not displayed if either of the following occurs: • Offline • Online and a module mismatch or communication error has occurred • Online and the module is not configured as a ring supervisor • Online and the module is not the Active Ring Supervisor • The ring fault condition is not Partial Network Fault or Rapid Fault/Restore Cycles

Table 39 - Module Properties: Network Tab Descriptions

Parameter	Description
Clear Fault	Clear Fault causes the Active Ring Supervisor to clear the Rapid Faults/Restore Cycles fault. Clear Fault is not displayed if either of the following occurs: • Offline • Online and a module mismatch or communication error has occurred • Online and the module is not configured as a ring supervisor • Online and the module is not the Active Ring Supervisor • The ring fault condition is not Rapid Fault/Restore Cycles
Advanced	Configure advanced network properties. Advanced appears dimmed if either of the following occurs: • Offline • Online and a module mismatch or communication error has occurred
Refresh Communication	Refresh communication appears when communication with the module has failed. Refresh communication attempts to refresh communication with the module.
Apply	When you click Apply or OK, the information is automatically sent to the controller if either of the following occurs: • You are online in Program, Remote Program or Remote Run mode • This controller is the owner controller • You have changed the configuration of the module in the software The controller tries to send the information to the module (if the connection of the module is not inhibited). If you do not click Apply, your changes are not sent to the controller.

Associated Axes Tab

The Associated Axes tab provides different functions depending on the drive you are configuring.

Kinetix 6500 and PowerFlex 755 Drives

For the Kinetix 6500 and PowerFlex 755, use the Associated Axes tab to do the following:

- Associate an axis from a list of axis tags.
- Create axis tags.
- Choose the Motor Feedback Device.
- Choose the Load Feedback Device.
- Choose the Master Feedback Device.

Each Kinetix 6500 drive module can have one full axis and one half axis. You assign the full (primary) axis as Axis 1: the (half) secondary axis as Axis 2. If you change the listed properties of Major Revision, feedback configuration, or power structure, the axis association is removed.

TIP Only the Kinetix 6500 drive supports a half axis.

When you remove an association, either by changing the module definition or selecting a different axis, causes the following to be reset:

- Association in the axis
- References to motors in the axis
- References to feedback devices in the axis
- Access the Axis Property category dialog boxes

Kinetix 350 Drive

For the Kinetix 350, use the Associated Axes tab to do the following:

- Associate an axis from a list of axis tags.
- Create axis tags.

Each drive module can have one full axis. If you change the drive's Major Revision module property, you will remove the axis association. The feedback configuration and power structure module properties are fixed.

When you remove an association, either by changing the module definition or selecting a different axis causes the following to be reset:

- Association in the axis.
- References to motors in the axis.
- References to feedback devices in the axis.
- Access the Axis Property category dialog boxes.

Kinetix 5500 Drive

- Associate an axis from a list of axis tags.
- Create axis tags.

Each drive module can have one full axis. If you change the drive's Major Revision module property, you remove the axis association. The feedback configuration and power structure module properties are fixed.

When you remove an association, either by changing the module definition or selecting a different axis causes the following to be reset:

- Association in the axis.
- References to motors in the axis.
- References to feedback devices in the axis.
- Access the Axis Property category dialog boxes.

Kinetix 5700 HPI and DAI Drive

For the Kinetix 5700 HPI and DAI Inverter modules, use the Associated Axes tab to do the following:

- Associate an axis from a list of axis tags.
- Create axis tags.
- Choose the Motor Feedback Device.
- Choose the Load Feedback Device.
- Choose the Master Feedback Device.

Each Kinetix K5700 HPI drive module can have one full axis and one half axis. Each Kinetix K5700 DAI drive module can have two pairs of this configuration:

- Instance 1 and 2, one full axis and one half axis
- Instance 3and 4, 2nd full axis and a 2nd half axis

You assign the full (primary) axis as Axis 1: the (half) secondary axis as Axis 2, and for DAI you assign the 2nd full axis as Axis.3, and the 2nd (half) secondary axis as Axis4. If you change the listed properties of Major Revision, feedback configuration, or power structure, the axis association is removed.

When you remove an association, either by changing the module definition or selecting a different axis, causes the following to be reset:

- Association in the axis.
- References to motors in the axis.
- References to feedback devices in the axis.
- Access the Axis Property category dialog boxes.

Figure 15 - Associated Axes Tab

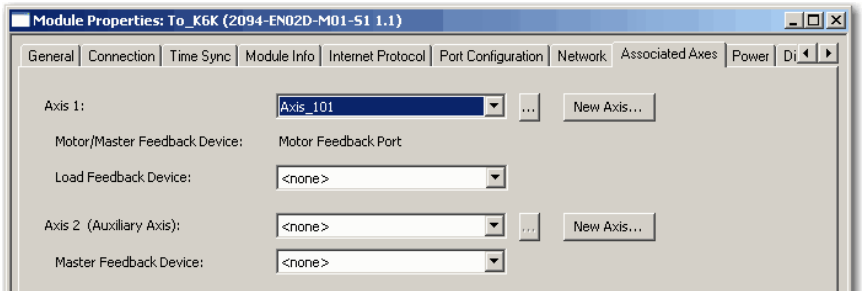


Table 40 - Module Properties: Associated Axis Tab Descriptions

Parameter	Description
Axis 1	Select the AXIS_CIP_DRIVE axis tag that you want to be associated as the full axis for the drive module.
Axis 2	Select the axis that you want to be the half axis, if needed.
New Axis	Opens the New Tag dialog box where you can create an AXIS_CIP_DRIVE axis.
Motor Feedback Device	The motor feedback device is set to Motor Feedback Port and cannot be changed.
Load Feedback Device	Click to select the port for the physical feedback device that is used by Axis 1 load feedback. Aux Feedback Port
Master Feedback Device	Choose the port for the physical feedback device that is used by Axis 2 master feedback.

Figure 16 - Associated Axes Tab for the Kinetix 5500 Drive

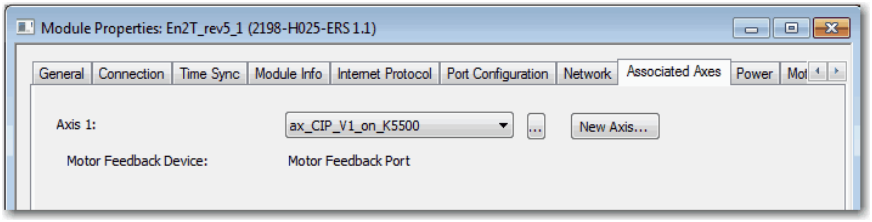


Figure 17 - Associated Axes Tab for the Kinetix 350 Drive

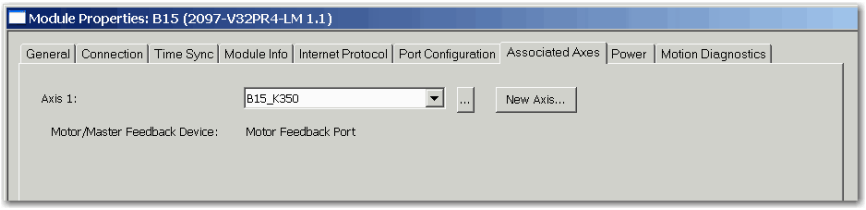


Figure 18 - Associated Axes Tab for the PowerFlex 755 Drive

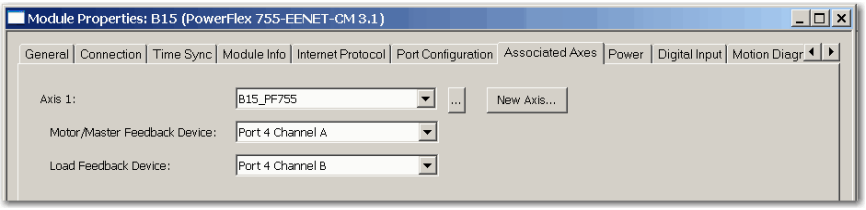


Figure 19 - Associated Axes Tab for the 5700 Drive and DAI 1

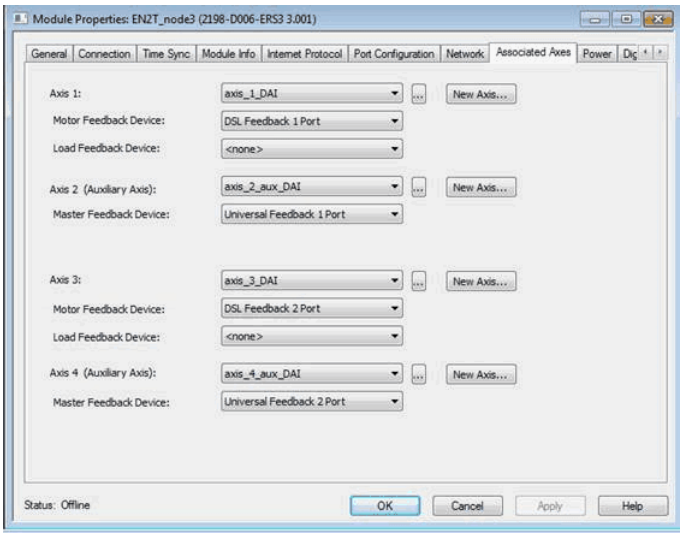
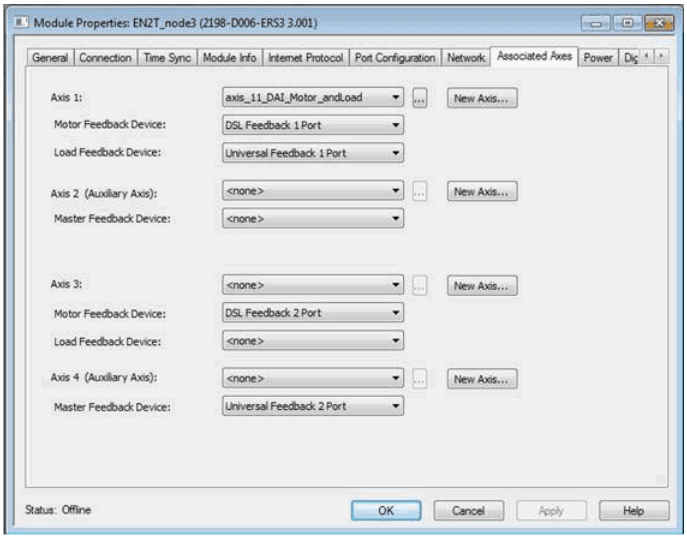


Table 41 - Module Properties: Associated Axis Tab Descriptions

Parameter	Description
Axis 1	Select the AXIS_CIP_DRIVE axis tag that you want to be associated as the full axis for the drive module.
Motor Feedback Device	Allows selection of the Motor feedback device for Axis 1. Selections: [DSL Feedback Port, Universal Feedback Port 1]
Load Feedback Device	Allows selection of the Load feedback device for Axis 1. Selections: [DSL Feedback Port, Universal Feedback Port 1]
Axis 2 (Auxiliary Axis)	Select the a xis that you want to be the half axis, if needed.
Master Feedback Device	Allows the selection of the Auxiliary axis feedback device. Selections: [DSL Feedback Port, Universal Feedback Port 1]

Figure 20 - Associated Axes Tab for the 5700 Drive and DAI 2



For more information about how to associate an axis, see Associate Axes and Drives on page 29 for the Kinetix drives and Configure the Associated Axis and Control Mode on page 31 for the PowerFlex 755 drive.

Power Tab

The parameters that display on this tab is different depending on the drive you are configuring, even within a drive family. It varies based on the Power Structure you select.

Figure 21 - Power Tab for the PowerFlex 755 Drive

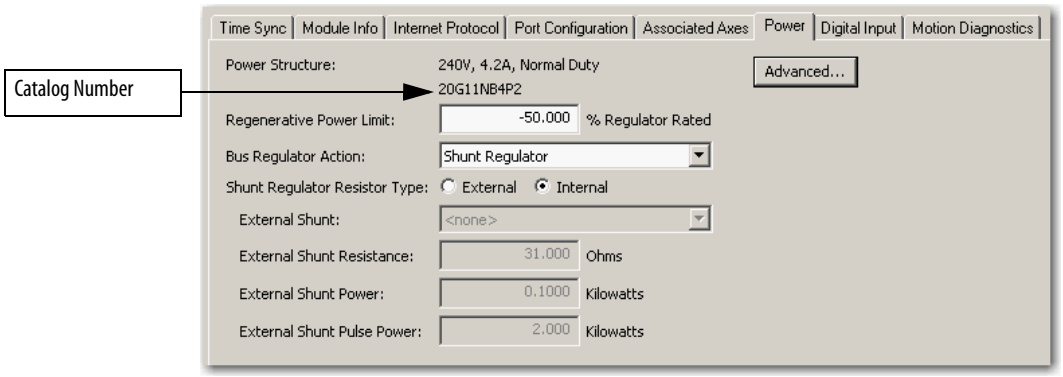


Figure 22 - Power Tab for the Kinetix 6500 Drive

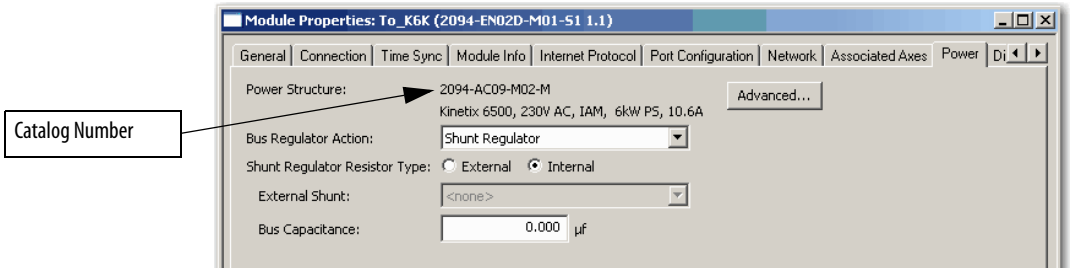


Figure 23 - Power Tab for the Kinetix 5500 Drive

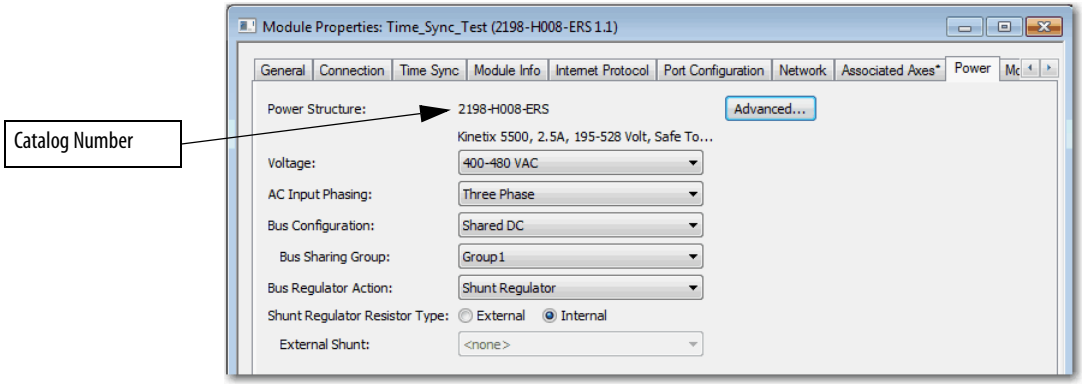


Figure 24 - Power Tab for the Kinetix 350 Drive

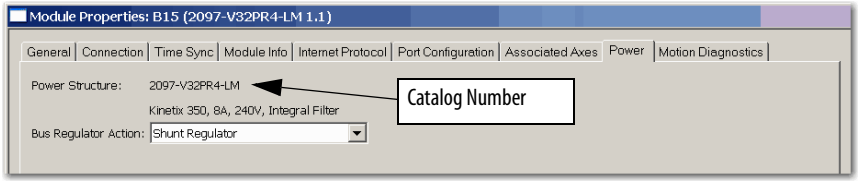


Table 42 - Module Properties: Power Tab Descriptions

Parameter	Description
Power Structure	Displays the drive catalog number and the drive power rating.
AC Input Phasing	Specify the AC input phasing. Valid values are 3 Phase and Single Phase.
Regenerative Power Limit	Enter a negative percentage value for the regenerative power limit.
Bus Regulator Action	Get or Set the bus regulator action to a configuration tag. Valid values include the following: • Disabled • Shunt Regulator • CommonBus Follower
Shunt Regulator Resistor Type	Select either an internal or external shunt. Shunt Regulator Resistor Type appears dimmed in online mode and when Bus Regulator Action is disabled (set to CommonBus Follower). The Kinetix 350 drive does not support this parameter.
External Shunt	These external shunt values are enabled when the Shunt Regulator Resistor Type is set to External. If you select External for the Shunt Regulator Resistor Type, choose the external shunt value. Valid values include the following: • <none> • Custom • The external shunt regulator catalog numbers
External Bus Capacitance Kinetix 6500 Drive Kinetix 350 and Kinetix 5500 do not support this parameter	When Bus Regulator Action is set to Shunt Regulator or CommonBus Follower, enter the External Bus Capacitance in µf. External Bus Capacitance is enabled when the Bus Regulator Action is set to Disabled or Shunt Regulator. Valid values are determined by the type of drive you are configuring. The value that you enter is validated when you click OK. You receive an error message if the value is over or under the valid range for the drive.
External Shunt Resistance	PowerFlex 755 Drive
External Shunt Power	PowerFlex 755 Drive
External Shunt Pulse Power	PowerFlex 755 Drive

You can change the overload and voltage limits when you are offline. You cannot make changes while online but the values are displayed.

Figure 25 - Kinetix 6500 Offline Display of the Advanced Limits Dialog Box

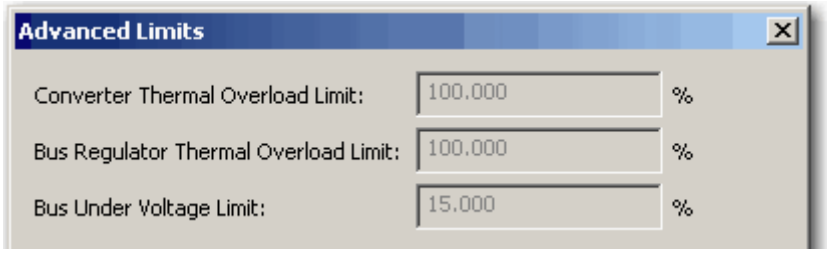


Figure 26 - Kinetix 5500 Offline Display of the Advanced Limits Dialog Box

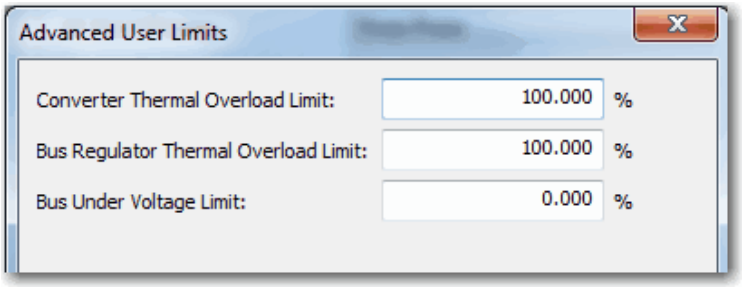
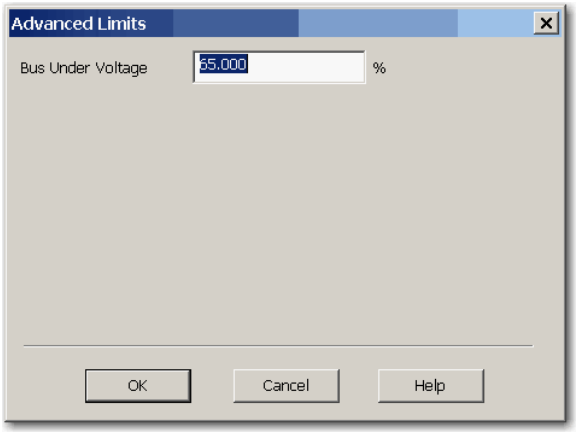


Figure 27 - PowerFlex 755 Offline Display of the Advanced Limits Dialog Box



The Kinetix 350 drive does not have an Advanced Limits dialog box.

Digital Input Tab

Use the Digital Input tab to enter digital input values for the drive module. These offline displays are the default values for the Kinetix 6500 and PowerFlex 755 Ethernet drives. The Kinetix 350 and the Kinetix 5500 drives do not have a Digital Input tab.

Figure 28 - Digital Input Tab for the Kinetix 6500 Drive

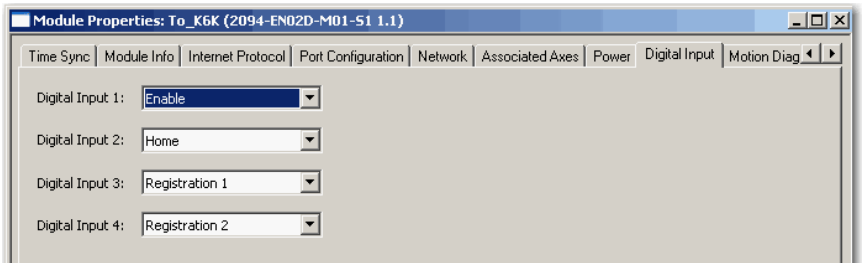


Figure 29 - Digital Input Tab for the PowerFlex 755 Drive

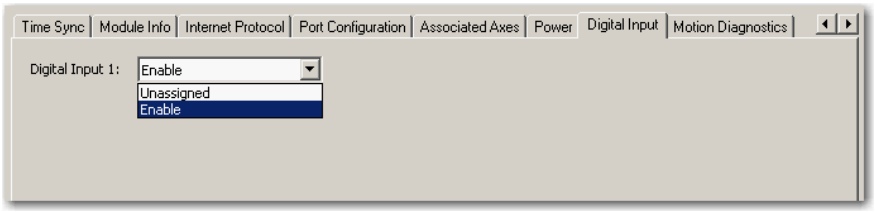


Table 43 - Module Properties: Digital Input Tab Descriptions

Parameter	Description
Digital Input 1 Digital Input 2 Digital Input 3 Digital Input 4	Choose one of these values for Digital Input 1, 2, 3, and 4: • Unassigned • Enable • Home • Registration 1 • Registration 2 • Positive Overtravel • Negative Overtravel • Regeneration OK

Motion Diagnostics Tab

When online, the Motion Diagnostics tab displays basic connection information that is related to the Motion Ethernet packet transmission rates. You can also go to the Transition Statistics dialog box to view Lost and Late transmissions and Timing Statistics. No values display during these conditions:

- Offline mode
- No axis is assigned to the module

Figure 30 - Motion Diagnostics Tab

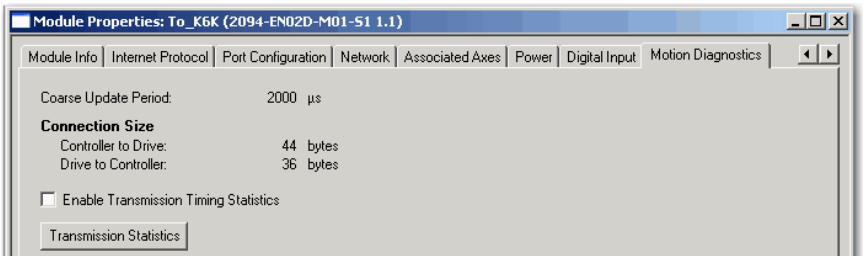
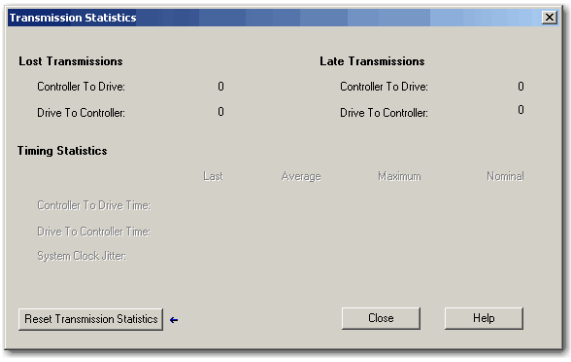


Table 44 - Module Properties: Motion Diagnostics Tab Descriptions

Parameter	Description
Course Update Period	Displays the associated motion group Base Update Period.
Controller to Drive	Displays the current size of the CIP connection to the drive.
Drive to Controller	Displays the current size of the CIP connection from the drive.
Enable Transmission Timing Statistics	View data on Lost and Late transmissions and Timing Statistics. The default is unchecked, which means timing statistics do not display on the Transmission Statistics dialog box. Checking this box displays the Transmission Statistic dialog box. • You can improve performance by not checking this box, which limits the amount of diagnostic data that appears on the Transmission Statistics dialog box. • Enable Transmission Timing Statistics appears dimmed in Hard Run mode. • Transmission Statistics appears dimmed in offline mode or when a connection error exists.

Figure 31 - Transmission Timing Statistics Dialog Box



Notes:

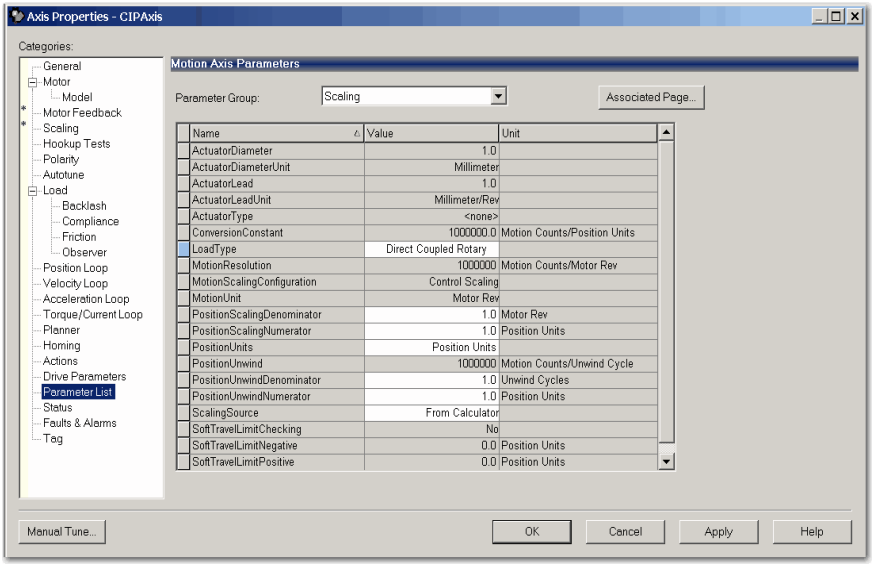
Parameter Group Dialog Boxes

This appendix describes the parameter group dialog boxes. You can access all parameters that are associated with each category dialog box by clicking Parameters on the dialog box.

Parameter Dialog Box Listings

Each Parameter dialog box list can contain more attributes than the associated category dialog box. In some cases, attributes that are contained on the Parameter List dialog box are not contained on the associated category dialog box.

Figure 32 - Scaling Parameters



You can configure advanced parameters only on the dialog box for that group and not all parameters can be set on each category dialog box.

This dialog box is an example of the parameters available for an axis that is configured as a Position Loop. There are six parameters that you can set on the Position Loop and Position Loop Parameter Group dialog boxes.

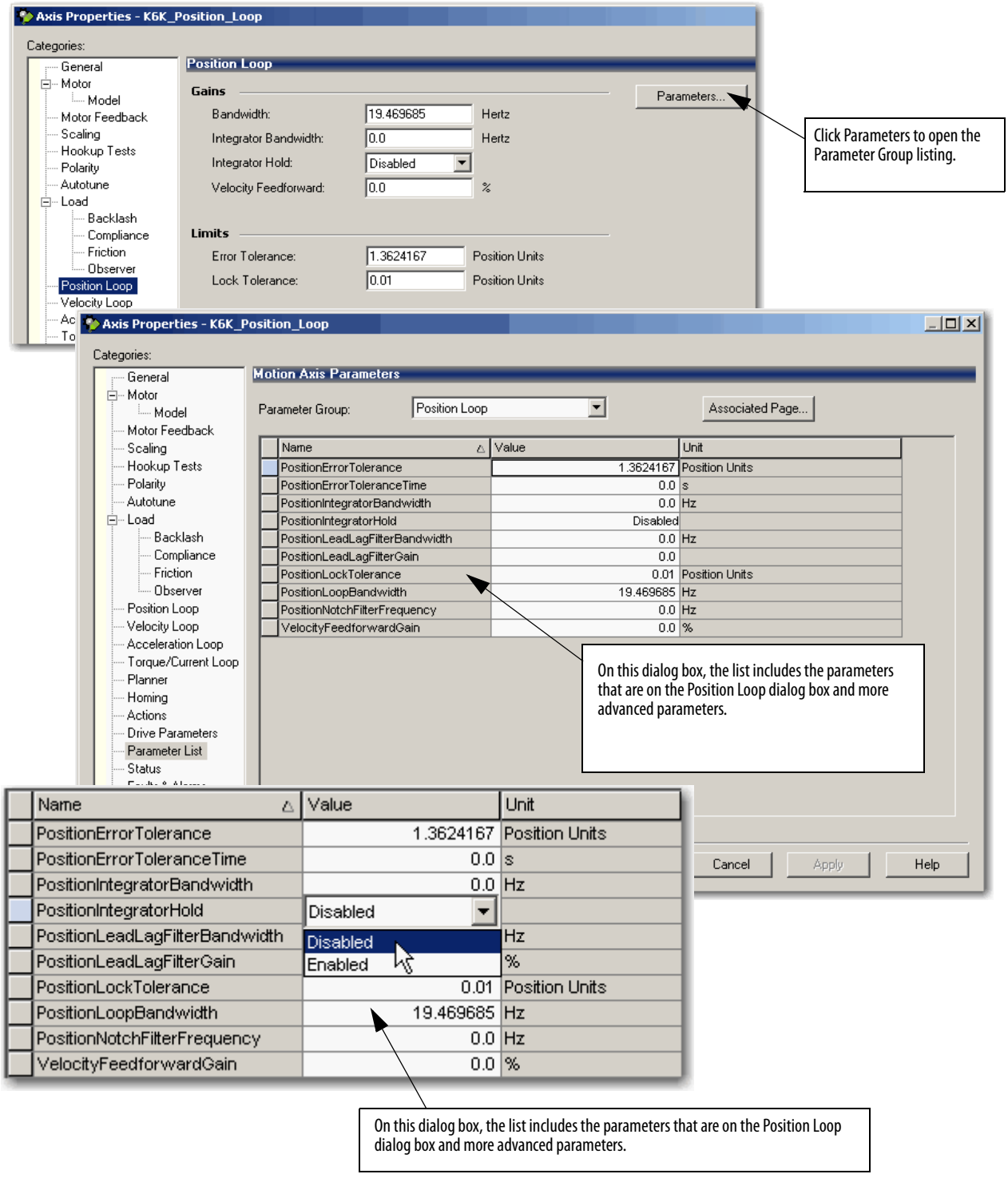
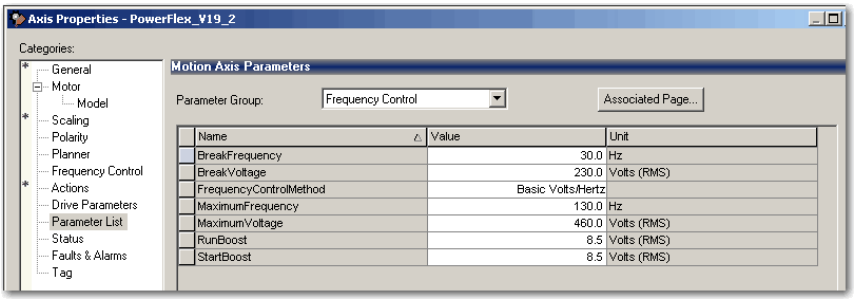


Figure 33 - Frequency Control Parameters



Notes:

Program

This chapter describes how to program a velocity profile and jerk rate.

Topic	Page
Program a Velocity Profile and Jerk Rate	255
Enter Basic Logic	266
Choose a Motion Instruction	268
Troubleshoot Axis Motion	271
Troubleshoot Axis Motion	271
Why does my axis overshoot its target speed?	272
Why is there a delay when I stop and then restart a jog?	275
Why does my axis reverse direction when I stop and start it?	277
Programming with the MDSC Function	279

Program a Velocity Profile and Jerk Rate

You can use either of these motion profiles for various instructions:

- **Trapezoidal** profile for linear acceleration and deceleration
- **S-curve** profiles for controlled jerk

Definition of Jerk

The Jerk is the rate of change of acceleration or deceleration.

The jerk parameters apply only to S-curve profile moves using these instructions:

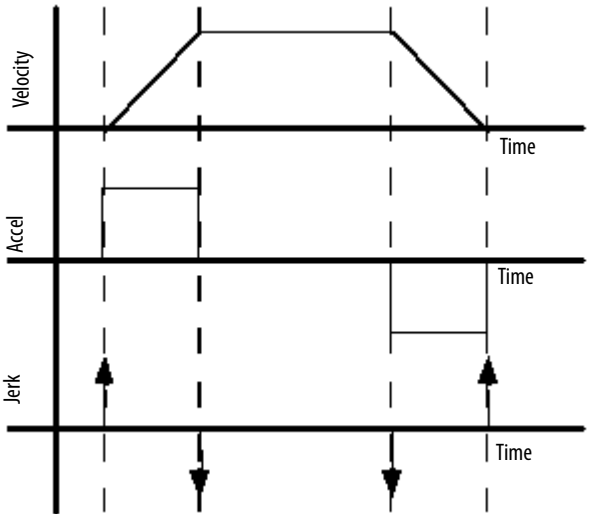
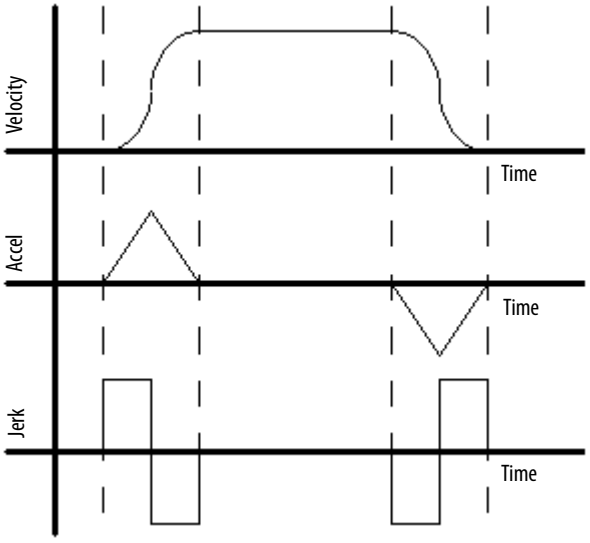
- MAJ
- MAM
- MAS
- MCD
- MCS
- MCCD
- MCCM
- MCLM

For example, if acceleration changes from 0 to 40 mm/s^2 in 0.2 seconds, the jerk is:

$$(40\ mm/s^2 - 0\ mm/s^2) / 0.2\ s = 200\ mm/s^3$$

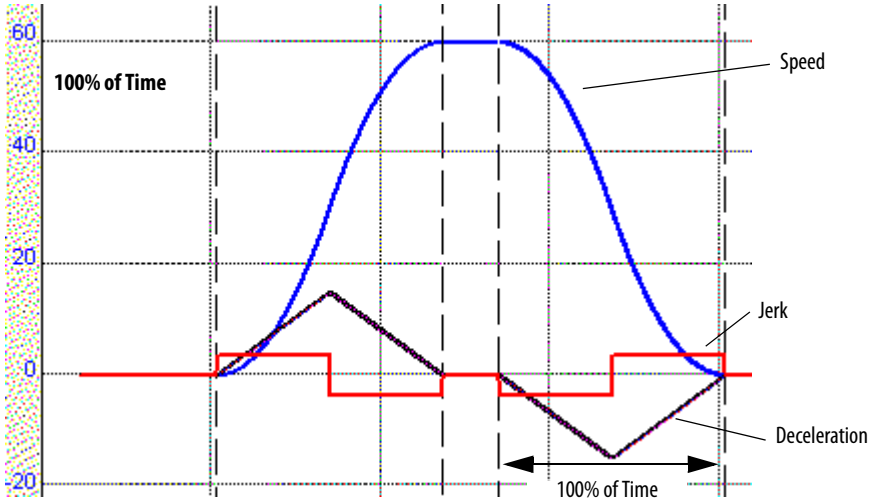
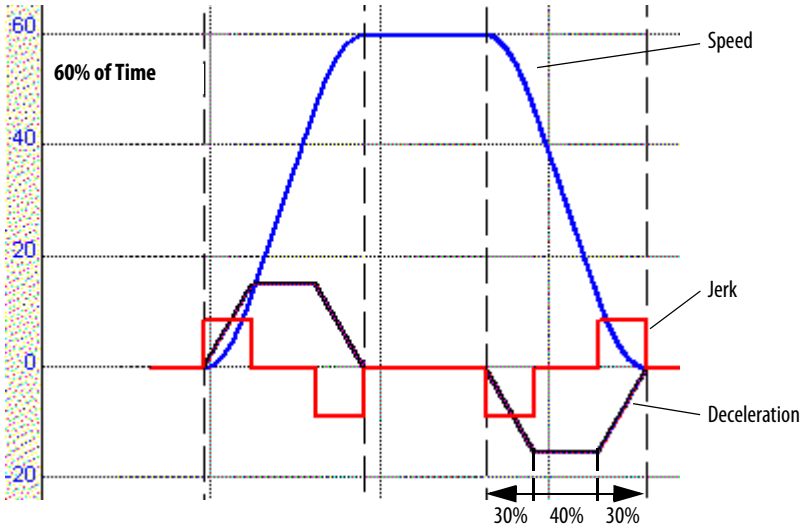
Choose a Profile

Consider cycle time and smoothness when you choose a profile.

If you want	Choose this profile	Consideration
• Fastest acceleration and deceleration times • More flexibility in programming subsequent motion	Trapezoidal 	Jerk **doesn't** limit the acceleration and deceleration time: • The Acceleration and Deceleration rates control the maximum change in Velocity. • Your equipment and load get more stress than with an S-curve profile. • Jerk is considered infinite and is shown as a vertical line.
Smoother acceleration and deceleration that reduces the stress on the equipment and load	S-curve 	Jerk limits the acceleration and deceleration time: • It takes longer to accelerate and decelerate than a trapezoidal profile. • If the instruction uses an S-curve profile, the controller calculates acceleration, deceleration, and jerk when you start the instruction. • The controller calculates triangular acceleration and deceleration profiles.

Use % of Time for the Easiest Programming of Jerk

Use % of Time to specify how much of the acceleration or deceleration time has jerk. You don't have to calculate actual jerk values.

Example	Profile
100% of Time	At 100% of Time, the acceleration or deceleration changes the entire time that the axis speeds up or slows down. 
60% of Time	At 60% of Time, the acceleration or deceleration changes 60% of the time that the axis speeds up or slows down. The acceleration or deceleration is constant for the other 40%. 

Velocity Profile Effects

This table summarizes the differences between profiles.

Profile	**ACC/DEC**	**Motor**	**Priority of Control**			
Type	Time	Stress	**Highest to Lowest**			
Trapezoidal	Fastest	Worst	Acc/Dec	Velocity	Position	
S-curve	2X Slower	Best	Jerk	Acc/Dec	Velocity	Position

Jerk Rate Calculation

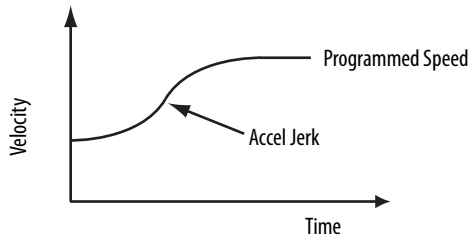
If the instruction uses or changes an S-curve profile, the controller calculates acceleration, deceleration, and jerk when you start the instruction.

The system has a Jerk priority planner. In other words, Jerk always takes priority over acceleration and velocity. Therefore, you always get the programmed Jerk. If a move is velocity-limited, the move does not reach the programmed acceleration and/or velocity.

Jerk Parameters for MAJ programmed in units of % time are converted to engineering units as follows:

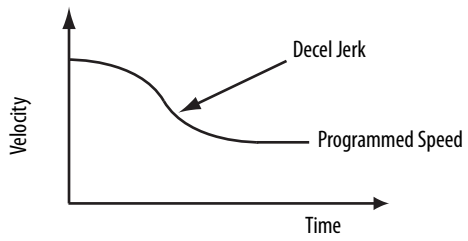
If Start Speed < MAJ Programmed Speed

$$\text{Accel Jerk (Units/Sec}^3\text{)} = \frac{\text{Programmed Accel Rate}^2}{\text{Programmed Speed}} * \left(\frac{200}{\text{\% of Time}} - 1 \right)$$



If Start Velocity > MAJ Programmed Speed

$$\text{Decel Jerk (Units/Sec}^3\text{)} = \frac{\text{Programmed Decel Rate}^2}{\text{Max (Programmed Speed, [Start Speed - Programmed Speed])}} * \left(\frac{200}{\text{\% of Time}} - 1 \right)$$

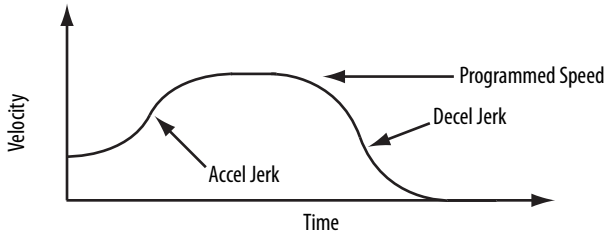


Jerks for programmed moves, such as MAM or MCLM instructions, in units of % time are converted to engineering units as follows:

If Start Speed < Programmed Speed

$$\text{Accel Jerk (Units/Sec}^3\text{)} = \frac{\text{Programmed Accel Rate}^2}{\text{Programmed Speed}} * \left(\frac{200}{\text{\% of Time}} - 1 \right)$$

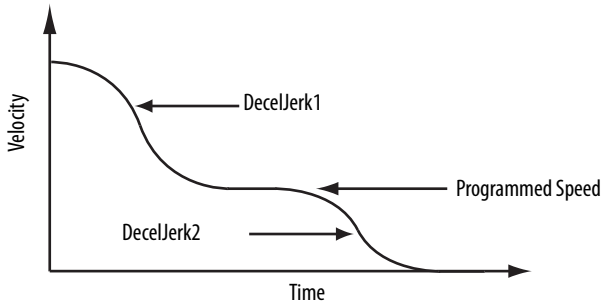
$$\text{Decel Jerk (Units/Sec}^3\text{)} = \frac{\text{Programmed Decel Rate}^2}{\text{Max (Programmed Speed, [Start Speed - Programmed Speed])}} * \left(\frac{200}{\text{\% of Time}} - 1 \right)$$



If Start Speed > Programmed Speed

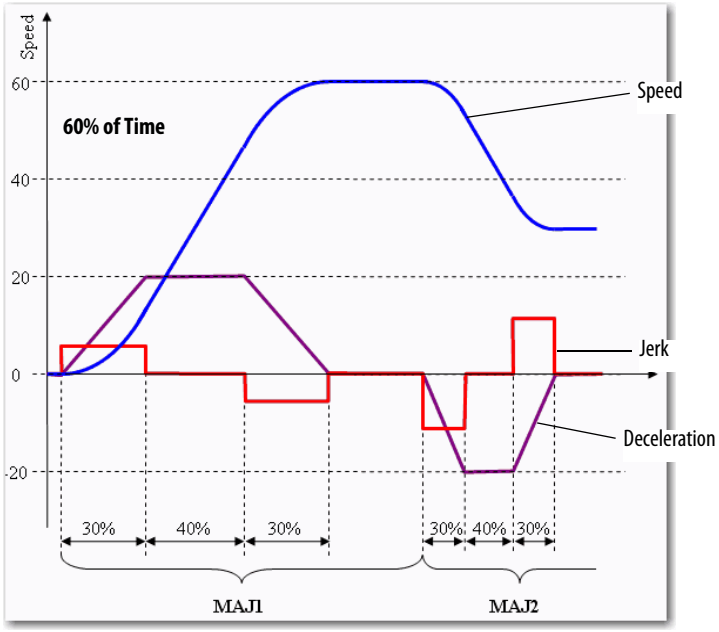
$$\text{DecelJerk1} = \frac{\text{Programmed Decel Rate}^2}{\text{Max (Programmed Speed, [Start Speed - Programmed Speed])}} * \left(\frac{200}{\text{\% of Time}} - 1 \right)$$

$$\text{DecelJerk2} = \frac{\text{Programmed Decel Rate}^2}{\text{Programmed Speed}} * \left(\frac{200}{\text{\% of Time}} - 1 \right)$$



DecelJerk1 is used while Current Speed > Programmed Speed
DecelJerk2 is used while Current Speed < Programmed Speed

Depending on the instruction's Speed parameter, the same '% of time' jerk can result in different slopes for the acceleration profile than on the deceleration profile.



The motion planner algorithm adjusts the actual jerk rate so that both the acceleration profile and the deceleration profile contain at least the '% of time' ramp time. If the Start Speed is close to the programmed Speed parameter, the actual percentage of ramp time can be higher than the programmed value.

In most cases, the condition is:

if: (start Speed is == 0.0) OR (start Speed is > 2 * max Speed)

then: you get **programmed** percentage of ramp time

else: you get **higher than programmed** percentage of ramp time

Conversion from% Time to Engineering Units

If you want to convert % of Time to Engineering Units, use these equations.

For Accel Jerk:

$$j_a\,[\%\ \text{of Time}] = \frac{2}{1 + \dfrac{j_a\,[EU/s^3]\ v_{max}\,[EU/s]}{a_{max}\,[EU/s^2]}}\ 100$$

For Decel Jerk:

$$j_d\,[\%\ \text{of Time}] = \frac{2}{1 + \dfrac{j_d\,[EU/s^3]\ v_{max}\,[EU/s]}{d_{max}\,[EU/s^2]}}\ 100$$

Jerk Programming in Units/Sec³

If you want to specify the jerk in 'Units/sec^3' instead of '% of time', adjust your jerk value as follows so that you get the value that you programmed.

$$\text{Temporary Speed} = \frac{\text{Programmed Decel Rate}^2}{\text{Desired Decel Jerk value in Units/Sec}^3}$$

$$k = \frac{\text{Start Speed - Programmed Speed}}{\text{Max (Programmed Speed, Temporary Speed)}}$$

if (k < 1)
- Instruction faceplate Decel jerk in Units/Sec^3 = Desired Decel Jerk in Units/Sec^3

else
- Instruction faceplate Decel jerk in Units/Sec^3 = Desired Decel Jerk in Units/Sec^3 * k

Unique Program Considerations

If you program a move by using the **% of Time** units, the programming software computes an **Accel Jerk** = a^2/v where a = the programmed **Accel Rate** and v = programmed **Speed.**

Therefore, the higher the programmed speed, the lower the computed Jerk. The system has a Jerk priority planner. In other words, Jerk always takes priority over acceleration and velocity.

Therefore, you always get the programmed Jerk. If a move is velocity-limited, the move does not reach the programmed acceleration and/or velocity. Once you reach the velocity limit for the length of the move, as the velocity is increased, the move takes longer and longer to complete.

Decel Jerk is computed similarly to the Accel Jerk described above. The only difference is that instead of a^2/v, Decel Jerk = d^2/v, where d = the programmed **Decel Rate**.

EXAMPLE Example #1

Start Speed = 8.0 in/sec

Desired Speed = 5.0 in/sec

Desired Decel Rate = 2.0 in/sec^2

Desired Decel Jerk = 1.0 in/sec^3

Temporary Speed = (Desired Decel Rate)^2 / Desired jerk value in Units/Sec^3

= 2.0^2 / 1.0 =

= 4.0 in/sec

k = (8.0 - 5.0) / max(5.0, 4.0) = 3.0 / 5.0 =

= 0.6

Because k < 1, we can enter the desired Decel jerk directly in the faceplate

Instruction faceplate Decel jerk in Units/Sec^3 = 1.0 in/sec^3

EXAMPLE Example #2

Start Speed = 13.0 in/sec

Desired Speed = 5.0 in/sec

Desired Decel Rate = 2.0 in/sec^2

Desired Decel Jerk = 1.0 in/sec^3

Temporary Speed = (Desired Decel Rate)^2 / Desired jerk value in Units/Sec^3

= 2.0^2 / 1.0 =

= 4.0 in/sec

k = (13.0 - 5.0) / max(5.0, 4.0) = 8.0 / 5.0 =

= 1.6

Because k > 1, we have to calculate the Decel jerk to use on the instruction faceplate as:

Instruction faceplate Decel jerk in Units/Sec^3 =

= 1.0 in/sec^3 * 1.6 =

= 1.6 in/sec^3

Which revision do you have?

- 15 or earlier – % of Time is fixed at 100.
- 16 or later – % of Time defaults to 100% of time on projects converted from earlier versions. For new projects, you must enter the Jerk value.

Profile Operand

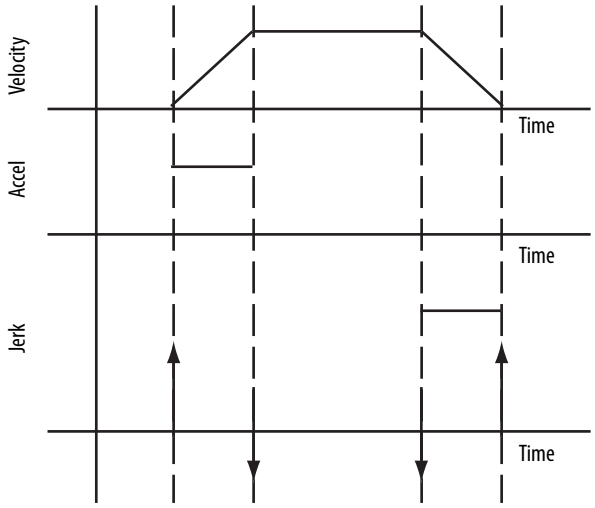
This operand has two profile types:

- Trapezoidal Velocity Profile
- S-curve Velocity Profile

Trapezoidal Velocity Profile

The trapezoidal velocity profile is the most commonly used profile because it provides the most flexibility in programming subsequent motion and the fastest acceleration and deceleration times. The change in velocity per unit time is specified by acceleration and deceleration. Jerk is not a factor for trapezoidal profiles. Therefore, it is considered infinite and is shown as a vertical line in the following graph.

Trapezoidal Accel/Decel Time



S-curve Velocity Profile

S-curve velocity profiles are most often used when the stress on the mechanical system and load needs to be minimized. The acceleration and deceleration time is balanced against the machine stress using two additional parameters, acceleration jerk and deceleration jerk.

Depending on the Jerk settings, the acceleration profile can be set to almost pure rectangular, see Trapezoidal Accel/Decel Time on page 263 (fastest and highest stress), or to triangular, see Programmable S-curve Accel/Decel Time, Acceleration Jerk = 60% of Time on page 265 (slowest, lowest stress).

The typical acceleration profile is a trade-off between stress and speed, as shown in S-curve Accel/Decel Time, Backward Compatibility Setting: Acceleration Jerk = 100% of Time on page 266.

The Jerk is either specified by the user (either in Units/sec^3 or as a percentage of maximum) or it is calculated from the percentage of time. (Percentage of time is equal to the percentage of ramp time in the acceleration/deceleration profile).

$$j_a\,[EU/s^3] = \frac{a_{max}{}^2\,[EU/s^2]}{v_{max}\,[EU/s]} \left(\frac{200}{j_a\,[\%\text{ of time}]} - 1 \right)$$

$$j_a\,[EU/s^3] = \frac{d_{max}{}^2\,[EU/s^2]}{v_{max}\,[EU/s]} \left(\frac{200}{j_a\,[\%\text{ of time}]} - 1 \right)$$

Backward Compatibility

The Jerk of 100% of time produces triangular acceleration and deceleration profiles. These profiles are ones that would have been previously produced as shown in S-curve Accel/Decel Time, Backward Compatibility Setting: Acceleration Jerk = 100% of Time on page 266.

Very small Jerk rates, that is less than 5% of time, produce acceleration and deceleration profiles close to rectangular ones, such as the one shown in Trapezoidal Accel/Decel Time on page 263.

IMPORTANT Higher values of the % of Time result in lower values of Jerk Rate Limits and, therefore, slower profiles. See the following table for reference.

Table 45 - Velocity versus Jerk

	Trapezoidal Velocity Profile(1)	S-shaped Velocity Profile with 1< = Jerk <100% of Time(2)	S-shaped Velocity Profile with Jerk = 100% of Time(3)
Accel/Decel Jerk in Units/sec^3	∞	$\frac{\text{Max Accel}^2}{\text{Max Velocity}}$ to ∞	$\frac{\text{Max Accel}^2}{\text{Max Velocity}}$
Accel/Decel Jerk in % of Maximum	NA	0 - 100%	NA
Accel/Decel Jerk in % of Time	0%	1 - 100%	100%

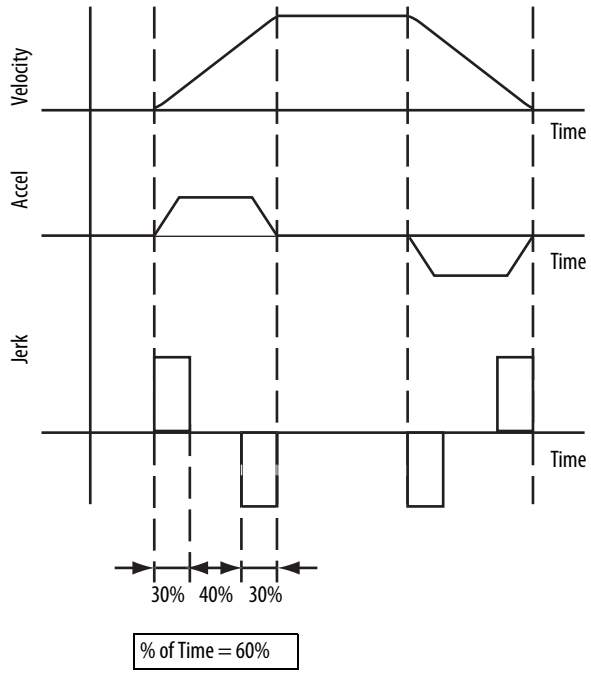
(1) The example on page 263 (labeled Trapezoidal Accel/Decel Time) uses a rectangular acceleration profile.

(2) The example on page 265 (labeled Programmable S-curve Accel/Decel Time, Acceleration Jerk = 60% of Time) uses a trapezoidal acceleration profile.

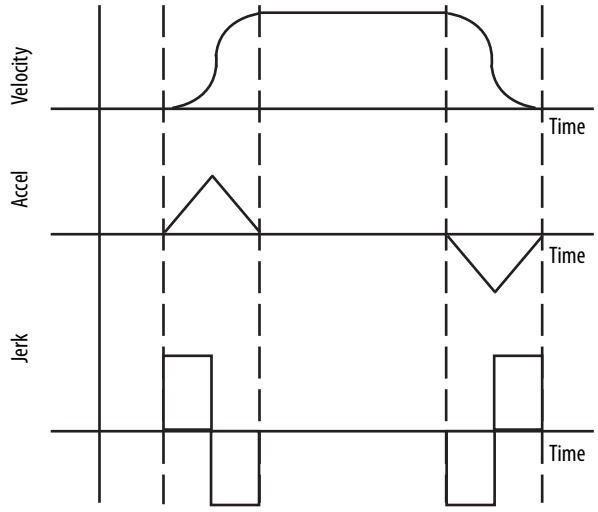
(3) The example on page 266 (labeled S-curve Accel/Decel Time, Backward Compatibility Setting: Acceleration Jerk = 100% of Time) uses a triangular acceleration profile.

Calculations are performed when an Axis Move, Change Dynamics, or an MCS Stop of StopType = Move or Jog is initiated.

Programmable S-curve Accel/Decel Time, Acceleration Jerk = 60% of Time



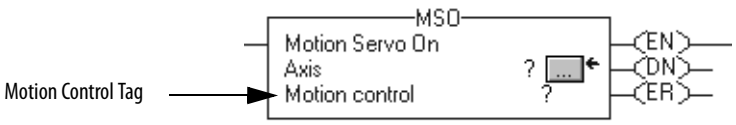
S-curve Accel/Decel Time, Backward Compatibility Setting: Acceleration Jerk = 100% of Time



Enter Basic Logic

The controller gives you a set of motion control instructions for your axes:

- Use these instructions just like the rest of the Logix Designer instructions. You can program motion control in these programming languages:
  - Ladder diagram (LD)
  - Structured text (ST)
  - Sequential function chart (SFC)
- Each motion instruction works on one or more axes.
- Each motion instruction needs a motion control tag. The tag uses a MOTION_INSTRUCTION data type. The tag stores the status information of the instruction.



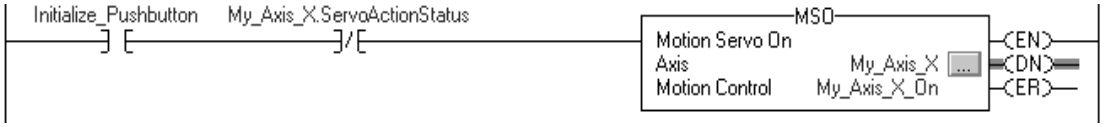
ATTENTION: Use the tag for the motion control operand of motion instruction only once. Unintended operation of the control variables may happen if you reuse the same motion control tag in other instructions.

Example Motion Control Program

This is an example of Ladder Logic that homes, jogs, and moves an axis.

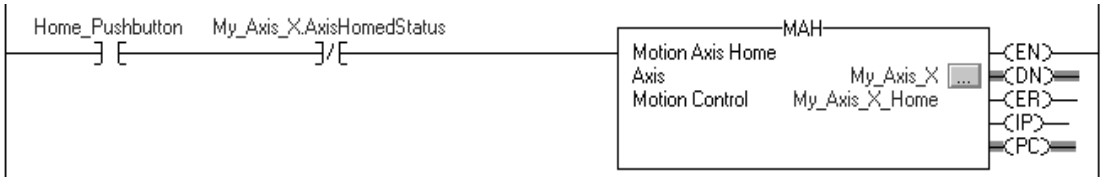
If *Initialize_Pushbutton* = on and the axis = off (*My_Axis_X.ServoActionStatus* = off) then

the MSO instruction turns on the axis.



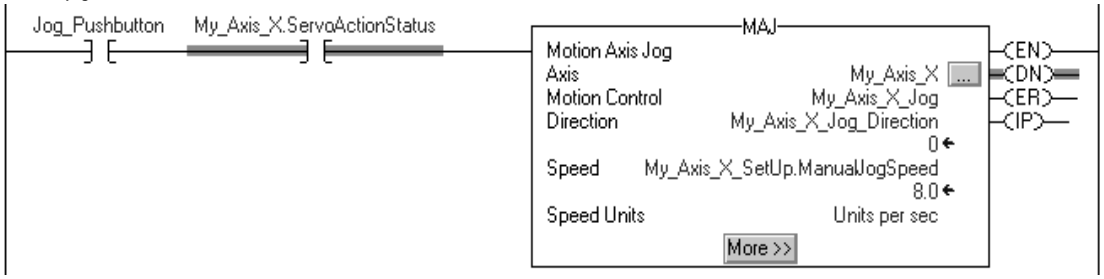
If *Home_Pushbutton* = on and the axis hasn't been homed (*My_Axis_X.AxisHomedStatus* = off) then

the MAH instruction homes the axis.



If *Jog_Pushbutton* = on and the axis = on (*My_Axis_X.ServoActionStatus* = on) then

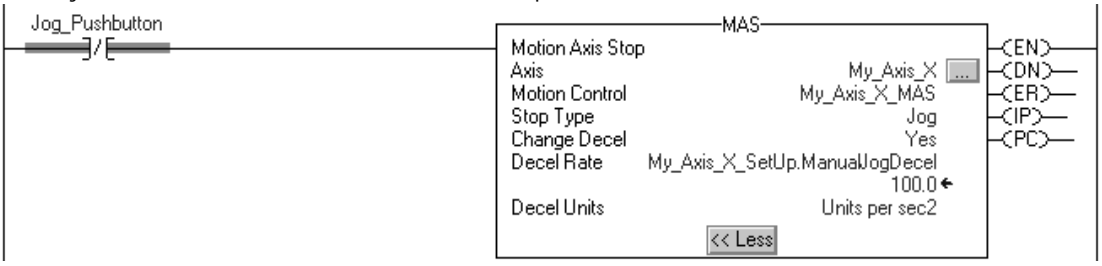
the MAJ instruction jogs the axis forward at 8 units/s.



If *Jog_Pushbutton* = off then

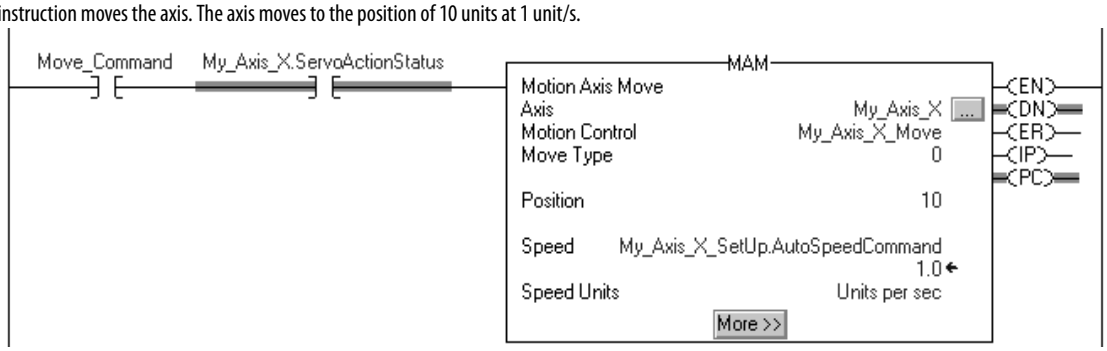
the MAS instruction stops the axis at 100 units/s^2.

Make sure that *Change Decel* is *Yes*. Otherwise, the axis decelerates at its maximum speed.



If *Move_Command* = on and the axis = on (*My_Axis_X.ServoActionStatus* = on) then

the MAM instruction moves the axis. The axis moves to the position of 10 units at 1 unit/s.



Download a Project and Run Logix

Follow these steps to download your program to a controller.

1. With the keyswitch, place the controller in Program or Remote Program mode.
2. From the Communications menu, choose Download.
3. Confirm that you wish to complete the download procedure.
4. Click Download.
5. Once the download is complete, place the controller in Run/Test mode.

   After the project file is downloaded, status and compiler messages appear in the status bar.

Choose a Motion Instruction

Use this table to choose an instruction and see if it is available as a Motion Direct Command.

Table 46 - Available Motion Direct Commands

If You Want To	And	Use This Instruction	Motion Direct Command
Change the state of an axis	Enable the drive and activate the axis loop.	MSO Motion Servo On	Yes
	Disable the drive and deactivate the axis loop.	MSF Motion Servo Off	Yes
	Force an axis into the shutdown state and block any instructions that initiate axis motion.	MASD Motion Axis Shutdown	Yes
	Reset the axis from the shutdown state.	MASR Motion Axis Shutdown Reset	Yes
	Activate the drive control loops for the CIP axis and run the motor at the specified speed.	MDS Motion Drive Start	
	Clear all motion faults for an axis.	MAFR Motion Axis Fault Reset	Yes

Table 46 - Available Motion Direct Commands

If You Want To	And	Use This Instruction	Motion Direct Command
Control axis position	Stop any motion process on an axis.	MAS Motion Axis Stop	Yes
	Home an axis.	MAH Motion Axis Home	Yes
	Jog an axis.	MAJ Motion Axis Jog	Yes
	Move an axis to a specific position.	MAM Motion Axis Move	Yes
	Start electronic gearing between two axes.	MAG Motion Axis Gear	Yes
	Change the speed, acceleration, or deceleration of a move or a jog that is in progress.	MCD Motion Change Dynamics	Yes
	Change the command or actual position of an axis.	MRP Motion Redefine Position	Yes
	Calculate a Cam Profile based on an array of cam points.	MCCP Motion Calculate Cam Profile	No
	Start electronic camming between two axes.	MAPC Motion Axis Position Cam	No
	Start electronic camming as a function of time.	MATC Motion Axis Time Cam	No
	Calculate the slave value, slope, and derivative of the slope for a cam profile and master value.	MCSV Motion Calculate Slave Values	No
Initiate action on all axes	Stop motion of all axes.	MGS Motion Group Stop	Yes
	Force all axes into the shutdown state.	MGSD Motion Group Shutdown	Yes
	Transition all axes to the ready state.	MGSR Motion Group Shutdown Reset	Yes
	Latch the current command and actual position of all axes.	MGSP Motion Group Strobe Position	Yes
Arm and disarm special event checking functions, such as registration and watch position	Arm the watch-position event checking for an axis.	MAW Motion Arm Watch Position	Yes
	Disarm the watch-position event checking for an axis.	MDW Motion Disarm Watch Position	Yes
	Arm the module registration-event checking for an axis.	MAR Motion Arm Registration	Yes
	Disarm the module registration-event checking for an axis.	MDR Motion Disarm Registration	Yes
	Arm an output cam for an axis and output.	MAOC Motion Arm Output Cam	No
	Disarm one or all output cams connected to an axis.	MDOC Motion Disarm Output Cam	No

Table 46 - Available Motion Direct Commands

If You Want To	And	Use This Instruction	Motion Direct Command
Tune an axis and run diagnostic tests for your control system. These tests include the following: • Motor/encoder hookup test • Encoder hookup test • Marker test	Run a tuning motion profile for an axis	MRAT Motion Run Axis Tuning	No
	Run one of the diagnostic tests on an axis.	MRHD Motion Run Hookup Diagnostic	No
Control multi-axis coordinated motion	Start a linear coordinated move for the axes of a coordinate system.	MCLM Motion Coordinated Linear Move	No
	Start a circular move for the axes of a coordinate system.	MCCM Motion Coordinated Circular Move	No
	Change in path dynamics for the active motion on a coordinate system.	MCCD Motion Coordinated Change Dynamics	No
	Stop the axes of a coordinate system or cancel a transform.	MCS Motion Coordinated Stop	No
	Shut down the axes of a coordinate system.	MCSD Motion Coordinated Shutdown	No
	Start a transform that links two coordinate systems together. This is like bi-directional gearing.	MCT Motion Coordinated Transform (1)	No
	Calculate the position of one coordinate system with respect to another coordinate system.	MCTP Motion Calculate Transform Position(1)	No
	Transition the axes of a coordinate system to the ready state and clear the axis faults.	MCSR Motion Coordinated Shutdown Reset	No

(1) You can only use this instruction with 1756-L6*x* or 1756-L6*x*S controllers.

Troubleshoot Axis Motion

This section helps you troubleshoot some situations that could happen while you are running an axis.

Example Situation	Page
Why does my axis accelerate when I stop it?	271
Why does my axis overshoot its target speed?	272
Why is there a delay when I stop and then restart a jog?	275
Why does my axis reverse direction when I stop and start it?	277

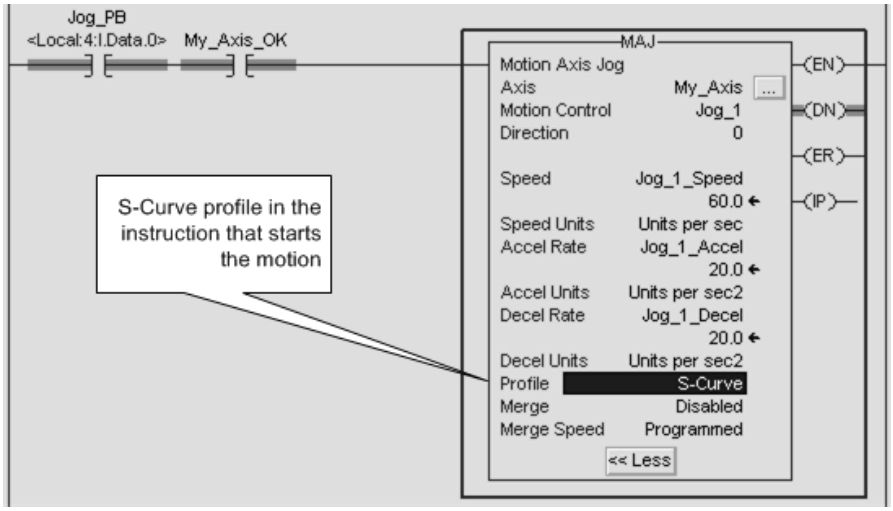
Why does my axis accelerate when I stop it?

While an axis is accelerating, you try to stop it. The axis keeps accelerating for a short time before it starts to decelerate.

Example

You start a Motion Axis Jog (MAJ) instruction. Before the axis gets to its target speed, you start a Motion Axis Stop (MAS) instruction. The axis continues to speed up and then eventually slows to a stop.

Look For

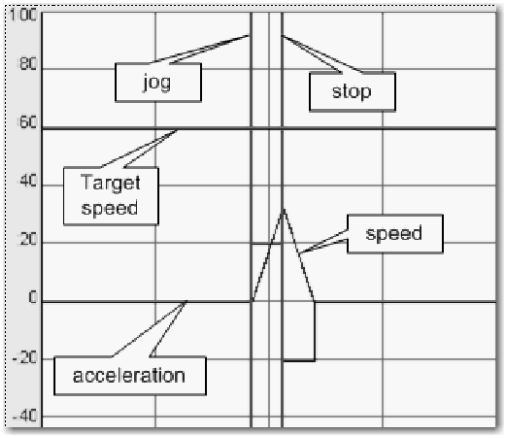
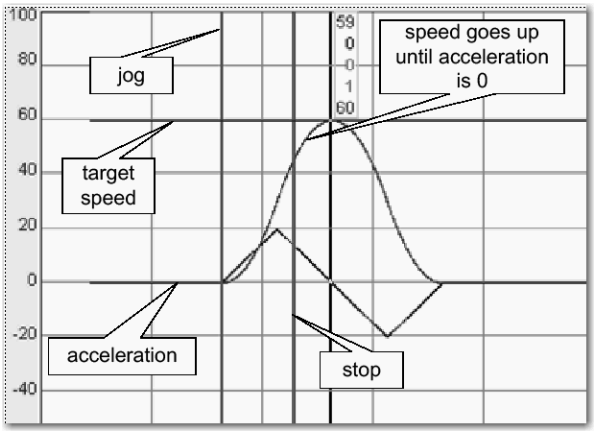


Cause

When you use an S-curve profile, jerk determines the acceleration and deceleration time of the axis:

- An S-curve profile has to get acceleration to 0 before the axis can slow down.
- The time it takes depends on the acceleration and speed.
- In the meantime, the axis continues to speed up.

The following trends show how the axis stops with a trapezoidal profile and an S-curve profile.

Stop while accelerating	**Trapezoidal**	**S-curve**
		
	The axis slows down as soon as you start the stopping instruction.	The axis continues to speed up until the S-curve profile brings the acceleration rate to 0.

Corrective Action

If you want the axis to slow down right away, use a trapezoidal profile.

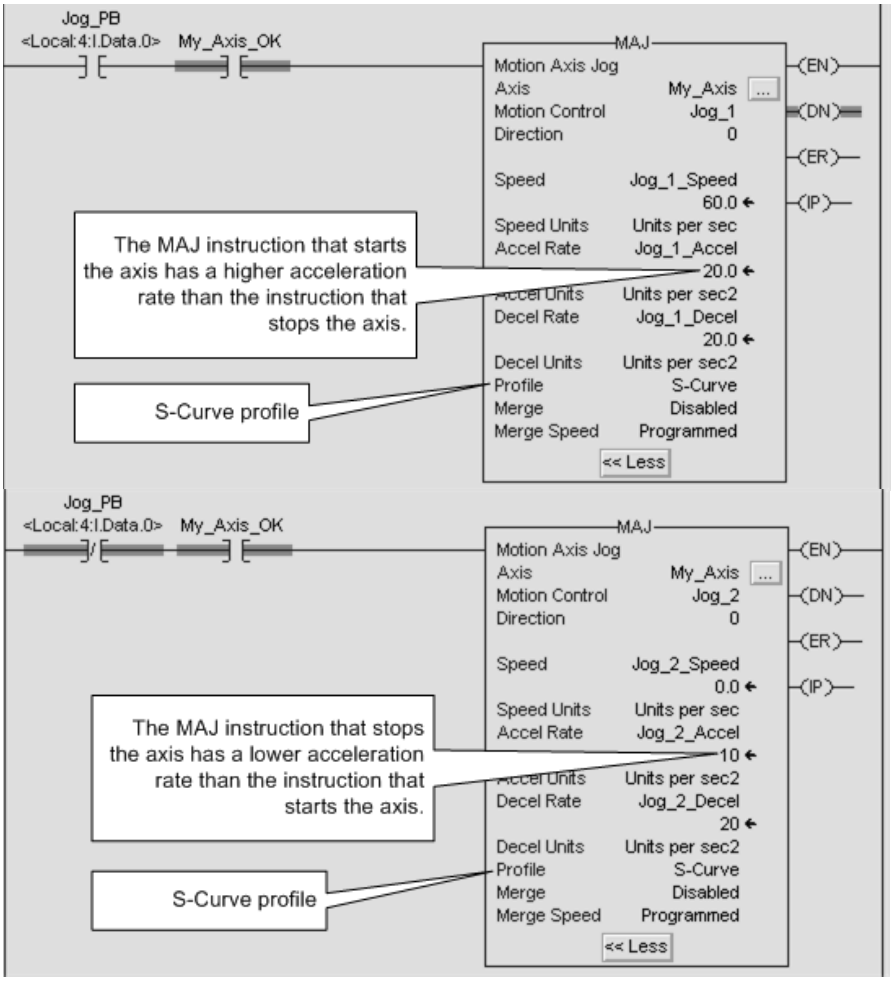
Why does my axis overshoot its target speed?

While an axis is accelerating, you try to stop the axis or change its speed. The axis keeps accelerating and goes past its initial target speed. Eventually it starts to decelerate.

Example

You start a Motion Axis Jog (MAJ) instruction. Before the axis gets to its target speed, you try to stop it with another MAJ instruction. The speed of the second instruction is set to 0. The axis continues to speed up and overshoots its initial target speed. Eventually it slows to a stop.

Look For



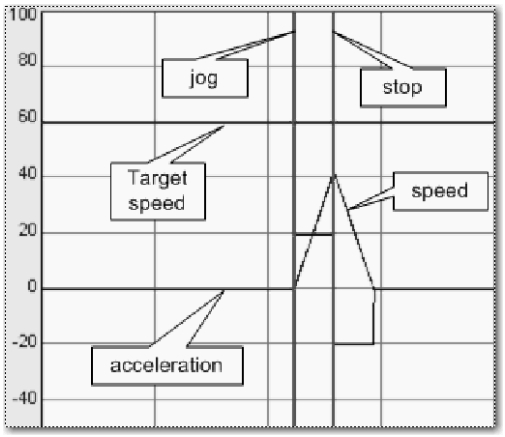
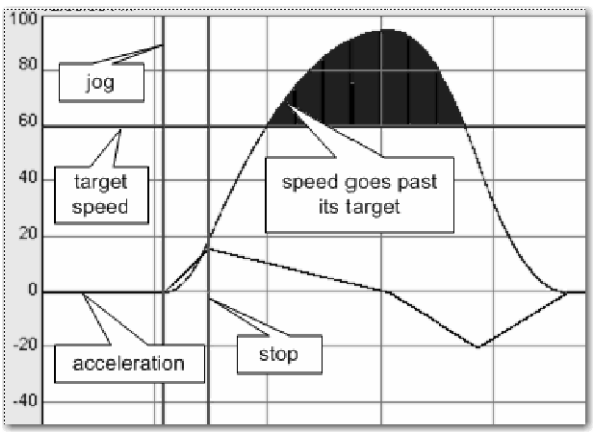
Cause

When you use an S-curve profile, jerk determines the acceleration and deceleration time of the axis:

- An S-curve profile has to get acceleration to 0 before the axis can slow down.
- If you reduce the acceleration, it takes longer to get acceleration to 0.
- In the meantime, the axis continues past its initial target speed.

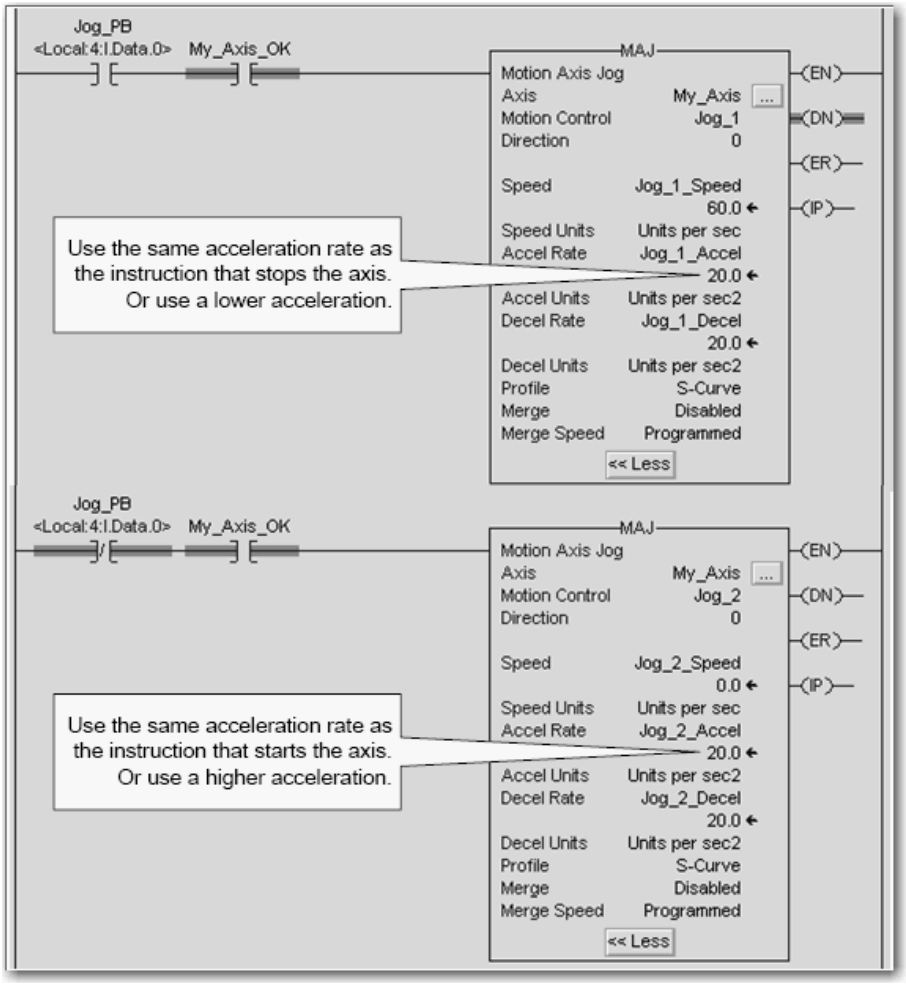
The following trends show how the axis stops with a trapezoidal profile and an S-curve profile.

Stop while accelerating and reduce the acceleration rate

	Trapezoidal	S-curve
		
	The axis slows down as soon as you start the stopping instruction. The lower acceleration doesn't change the response of the axis.	The stopping instruction reduces the acceleration of the axis. It now takes longer to bring the acceleration rate to 0. The axis continues past its target speed until acceleration equals 0.

Corrective Action

Use a Motion Axis Stop (MAS) instruction to stop the axis or set up your instructions like this.



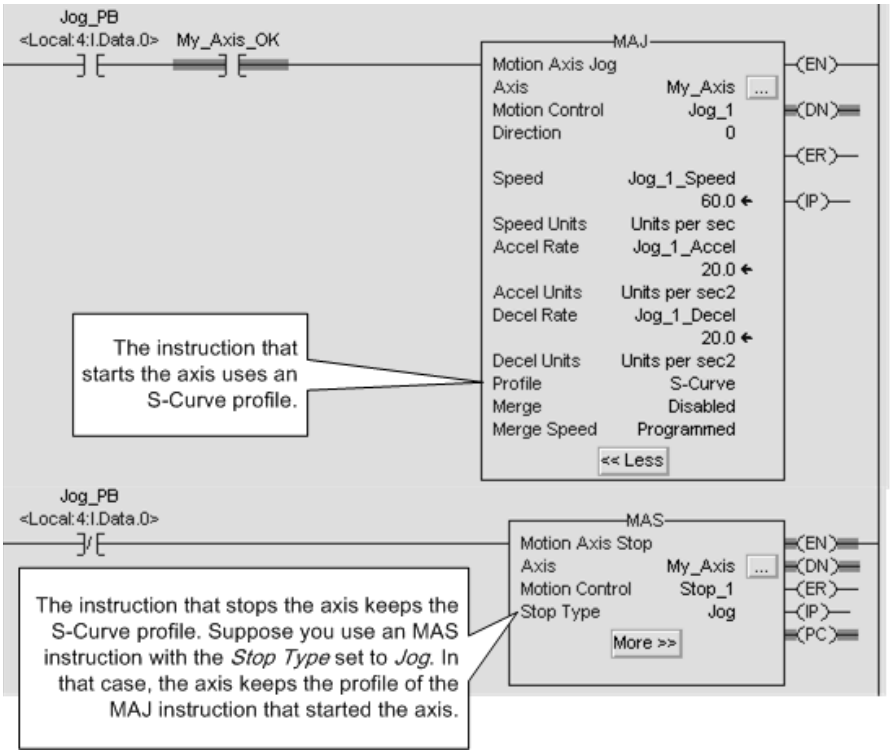
Why is there a delay when I stop and then restart a jog?

While an axis is jogging at its target speed, you stop the axis. Before the axis stops completely, you restart the jog. The axis continues to slow down before it speeds up.

Example

You use a Motion Axis Stop (MAS) instruction to stop a jog. While the axis is slowing down, you use a Motion Axis Jog (MAJ) instruction to start the axis again. The axis doesn't respond right away. It continues to slow down. Eventually it speeds back up to the target speed.

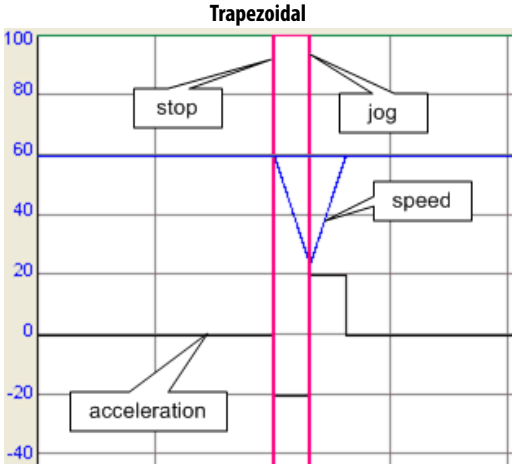
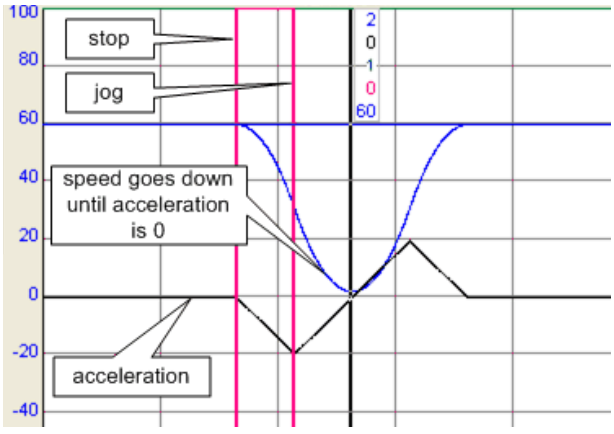
Look For



Cause

When you use an S-curve profile, jerk determines the acceleration and deceleration time of the axis. An S-curve profile has to get acceleration to 0 before the axis can speed up again. The following trends show how the axis stops and starts with a trapezoidal profile and an S-curve profile.

Start while decelerating

Trapezoidal	S-curve
	
The axis speeds back up as soon as you start the jog again.	The axis continues to slow down until the S-curve profile brings the acceleration rate to 0.

Corrective Action

If you want the axis to accelerate right away, use a trapezoidal profile.

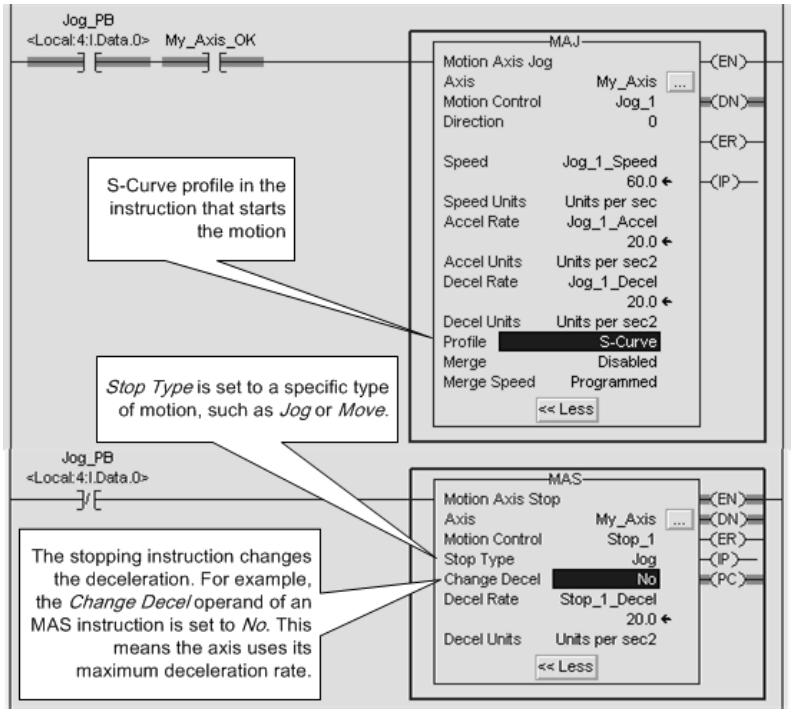
Why does my axis reverse direction when I stop and start it?

While an axis is jogging at its target speed, you stop the axis. Before the axis stops completely, you restart the jog. The axis continues to slow down and then reverses direction. Eventually the axis changes direction again and moves in the programmed direction.

Example

You use a Motion Axis Stop (MAS) instruction to stop a jog. While the axis is slowing down, you use a Motion Axis Jog (MAJ) instruction to start the axis again. The axis continues to slow down and then moves in the opposite direction. Eventually it returns to its programmed direction.

Look For



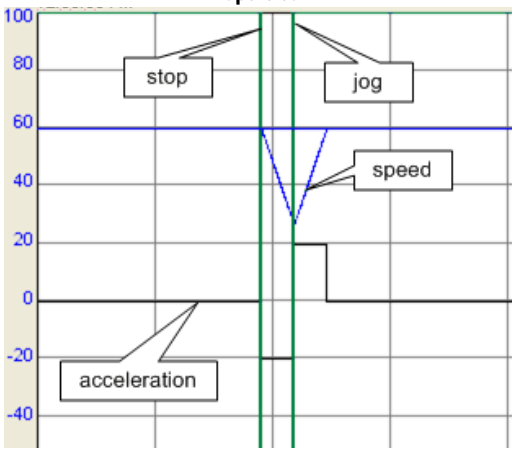
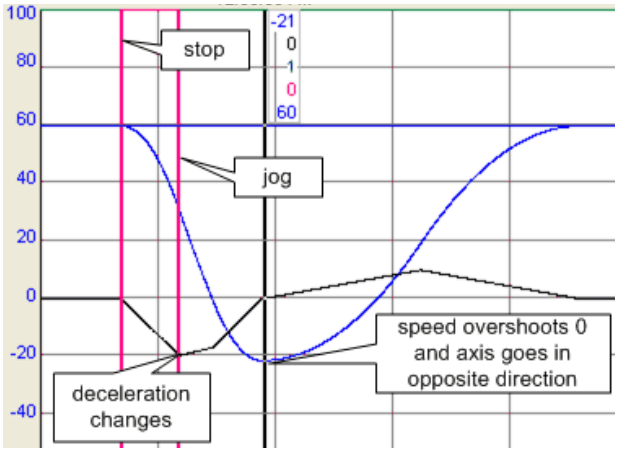
Cause

When you use an S-curve profile, jerk determines the acceleration and deceleration time of the axis:

- An S-curve profile has to get acceleration to 0 before the axis can speed up again.
- If you reduce the acceleration, it takes longer to get acceleration to 0.
- In the meantime, the axis continues past 0 speed and moves in the opposite direction.

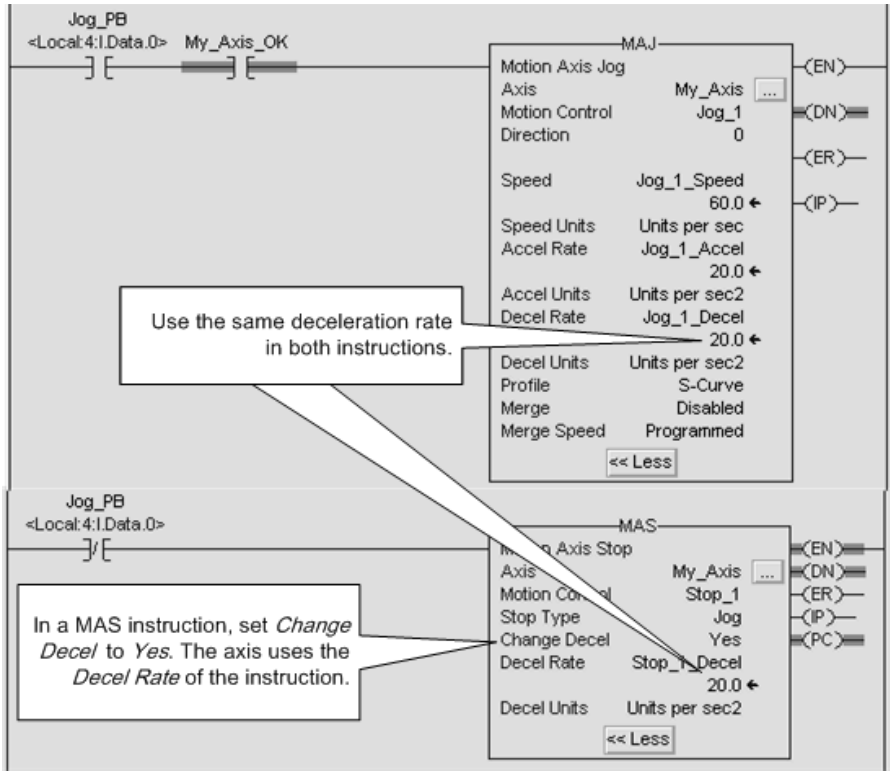
The following trends show how the axis stops and starts with a trapezoidal profile and an S-curve profile.

Start while decelerating and reduce the deceleration rate

Trapezoidal	S-curve
	
The axis speeds back up as soon as you start the jog again. The lower deceleration doesn't change the response of the axis.	The jog instruction reduces the deceleration of the axis. It now takes longer to bring the acceleration rate to 0. The speed overshoots 0 and the axis moves in the opposite direction.

Corrective Action

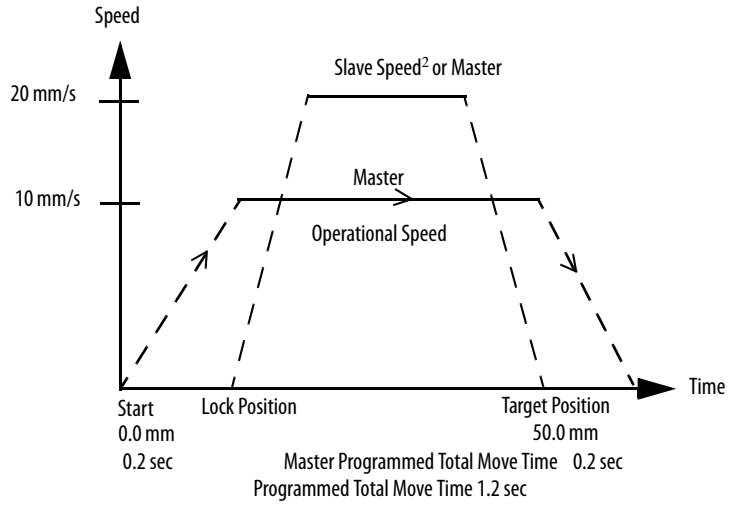
Use the same deceleration rate in the instruction that starts the axis and the instruction that stops the axis.



Programming with the MDSC Function

This is an example of programming motion with the MDSC functionality. In this example, we illustrate a 50.0 mm move.

Figure 34 - Slave Speed Control from Master with Lock Position, MDSC Time Based



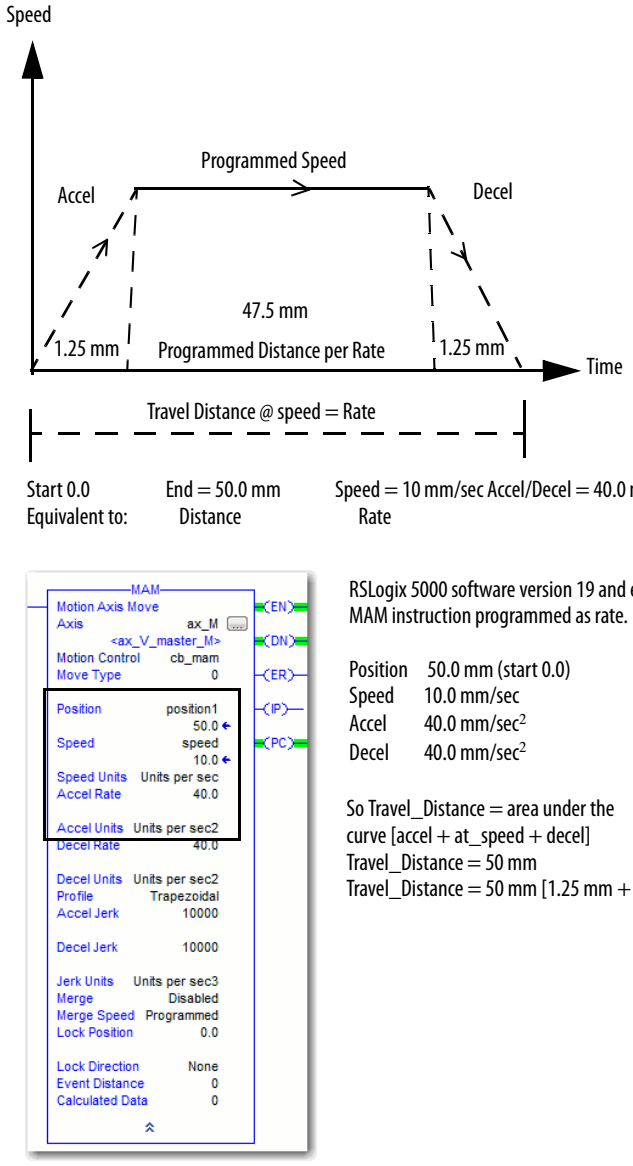
Slave: Speed= 2.0^2 MasterUnits, accel/decell = 2.0 [Master Units]
Lock Position = 10.0

Table 47 - Comparison of the Enumerations for the Motion Instructions

Revision	Operand	Units	Type	Profile
V19 and earlier	Speed	Units/sec	Rate	Trapezoidal, S-curve
(PJerk)	Accel/Decel	Units/sec^2	Rate	
	Jerk	Units/sec^3	Rate	
		% of time	Time	
	Speed, Accel/Decel, and Jerk	% of max % of units/sec	Rate	
For instructions: MAM, MAJ, MCD, and MAS				
V20	Speed	Units/sec	Rate	Trapezoidal, S-curve
		Sec	Time	Trapezoidal, S-curve
		Master units	Feedback	Trapezoidal, S-curve
	Accel/Decel	Units/sec^2	Rate	Trapezoidal, S-curve
		Sec	Time	Trapezoidal, S-curve
		Master units	Feedback	Trapezoidal, S-curve
	Jerk	Units/sec^2	Rate	Trapezoidal, S-curve
		Sec	Time	Trapezoidal, S-curve
		Master units	Feedback	Trapezoidal, S-curve
For instructions, MDSC, MAM, MAJ, and MATC				

In this figure, we are programming rate. The controller calculates the time of the move: Speed & Accel/Decel as units = units (seconds).

Figure 35 - Programming Rate in RSLogix 5000 Software Version 19 and Earlier



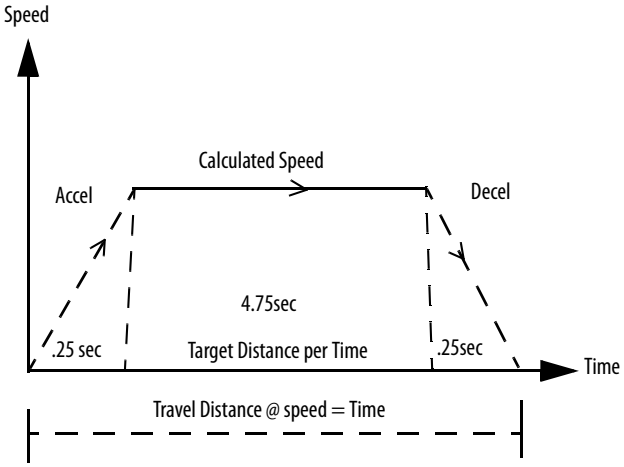
RSLogix 5000 software version 19 and earlier MAM instruction programmed as rate.

Position	50.0 mm (start 0.0)
Speed	10.0 mm/sec
Accel	40.0 mm/sec^2
Decel	40.0 mm/sec^2

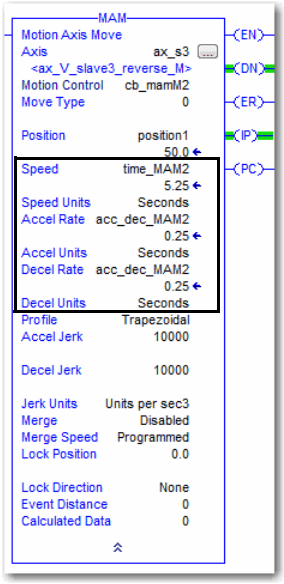
So Travel_Distance = area under the curve [accel + at_speed + decel]
Travel_Distance = 50 mm
Travel_Distance = 50 mm [1.25 mm + 47.5 mm + 1.25 mm

In this figure, we are programming time. The controller calculates the speed of the move: Speed & Accel/Decel as time [seconds]

Figure 36 - Programming Time in RSLogix 5000 Software Version 20 and Later



Start 0.0 Equivalent to: | End = 50.0 mm Distance | Speed = 10 mm/sec Time | Accel/Decel = 0.25 sec



RSLogix 5000 software version 20 and later MAM instruction programmed as time.

Position	50.0 mm (start 0.0)
Speed	5.25 sec
Accel	0.25 sec
Decel	0.25 sec

So Travel_Distance = area under the curve [accel + at_speed + decel]
Travel_Distance = 50 mm
Travel_Time = 5.25 sec [0.25 + 4.75 + 0.25 sec]

Notes:

History of Changes

This appendix summarizes the revisions to this manual. Reference this appendix if you need information to determine what changes have been made across multiple revisions. This may be especially useful if you are deciding to upgrade your hardware or software based on information added with previous revisions of this manual.

This table contains the changes that were made in MOTION-UM003E-EN-P

Topic	Page
Added a chapter for the Axis Scheduling feature.	77
Added content for Safe Torque Off feature.	9, 170
Updated Motion Group Properties dialog box content and graphics	Throughout
Updated graphics to reflect Studio 5000® environment, version 24	Throughout
Added Understanding STO Bypass When Using Motion Direct Commands	173
Added Safety Tab	227

This table contains the changes that were made in MOTION-UM003D-EN-P.

Topic	Page
Updated graphics for Logix Designer software, version 21.00.00	Throughout
Added information related to the Kinetix® 5500 Ethernet drive	Throughout
Added Studio 5000™ Engineering and Design Environment Information	Preface
Updated What You Need	10
Added Integrated Motion EtherNet/IP Drives Table	11
Updated Configuration and Start-up Scenarios	12
Where to Find Sample Projects	14
Updated Create a Controller Project	17
Updated Set Time Synchronization	20
Updated Add a 1756-ENxTx Communication Module	22
Updated Configuring a Kinetix Drive	28
Updated Add a Kinetix EtherNet/IP Drive	28
Updated Create an Associated Axis	32
Updated Configuring the General Parameters	35
Added Integrated Architecture Builder	45, 97
Updated Specifying the Motor Data Source	46
Added Example 4: Kinetix 5500 Drive, Velocity Loop with Motor Feedback	68
Added Example 5: Kinetix 350 Drive, Position Loop with Motor Feedback	72
Update Screen Captures in Configure Integrated Motion Using a PowerFlex 755 Drive	77
Updated Absolute Position Recovery Scenarios	173

Notes:

The following terms and abbreviations are used throughout this manual. For definitions of terms that are not listed here, refer to the Allen-Bradley Industrial Automation Glossary, publication AG-7.1.

Absolute Position Retention (APR) While Homing creates an absolute machine reference position, the APR bit is designed to retain the absolute position.

Axis An axis is a logical element of a motion control system that exhibits some form of movement. Axes can be rotary or linear, physical or virtual, controlled or simply observed.

Bus Regulator A bus regulator is used to limit the rise in DC Bus voltage level that occurs when decelerating a motor.

CIP Common Industrial Protocol.

CIP Sync CIP Sync defines extensions to CIP Common objects and device profiles to support time synchronization over CIP Networks.

Closed Loop Closed loop is a method of control where there is a feedback signal of some kind that is used to drive the actual dynamics of the motor to match the commanded dynamics by servo action. In most cases, there is a literal feedback device to provide this signal, but in some cases the signal is derived from the motor excitation, for example, sensorless operation.

Converter A converter is a device that generally converts AC input to DC output. A Converter is also commonly called the Drive Power Supply. In the context of a drive system, the Converter is responsible for converting AC Main input into DC Bus power.

Course (Base) Update Period The base update period of the motion group's update task, which is specified in milliseconds.

Cyclic Data Block The cyclic data block is a high priority real-time data block that is transferred by an Integrated Motion on the EtherNet/IP network connection on a periodic basis.

Drive A drive is a device that is designed to control the dynamics of a motor.

Event Data Block The event data block is a medium priority real-time data block that is transferred by an Integrated Motion on the EtherNet/IP network connection only after a specified event occurs. Registration and marker input transitions are typical drive events.

Get/Read A Get/Read involves retrieving an attribute value from the perspective of Controller side of the interface.

Integrated Motion on the EtherNet/IP Network Defines extensions to CIP Common objects and device profiles to support motion control over CIP networks.

Integrated Motion on the EtherNet/IP network I/O Connection The I/O connection is the periodic bidirectional, Class 1, CIP connection between a controller and a drive that is defined as part of the Integrated Motion on the EtherNet/IP network standard.

Integrated Motion on the EtherNet/IP Network Drive Refers to any drive device that complies with the CIP Motion standard.

Inverter An inverter is a device that generally converts DC input to AC output. An Inverter is also commonly called the Drive Amplifier. In the context of a drive system, the Inverter is responsible for controlling the application of DC Bus power to an AC motor.

Motion Motion refers to any aspect of the dynamics of an axis. In the context of this document, it is not limited to servo drives but encompasses all forms of drive based motor control.

Motion Group A user defined grouping of motion axes. A motion group has configuration parameters and status attributes that apply to all axes in the group.

Multiplexing Multiplexing is the method by which multiple signals are combined into one signal for transmission.

Multiplex Update Multiplier Number of multiplexed drives that determines the multiplex update period.

Multiplex Update Period Task update period for a Multiplexed Axis.

Open Loop Open loop is a method of control where there is no application of feedback to force the actual motor dynamics to match the commanded dynamics. Examples of open loop control are stepper drives and variable frequency drives.

Safe Torque Off The Safe Torque Off (STO) feature provides a method, with sufficiently low probability of failure, to force the power-transistor control signals to a disabled state. When the command to allow torque ceases from the GuardLogix controller, all of the drive output-power transistors are released from the On-state.

For complete information about the Safe Torque Off feature, see the Kinetix Multi-axis servo EtherNet/IP drive User Manual, publication 2198-UM002.

Service Data Block The service data block is a lower priority real-time data block associated with a service message from the controller that is transferred by an Integrated Motion on the EtherNet/IP network connection on a periodic basis. Service data includes service request messages to access attributes, run a drive-based motion planner, or perform various drive diagnostics.

Set/Write A Set/Write involves setting an attribute to a specified value from the perspective of the Controller side of the interface.

Shunt Regulator A shunt regulator is a specific Bus Regulator method that switches the DC Bus across a power dissipating resistor to dissipate the regenerative power of a decelerating motor.

Synchronized Synchronized is a condition where the local clock value on the drive is locked onto the master clock of the distributed System Time. When synchronized, the drive and controller devices can use time stamps that are associated with an Integrated Motion on the EtherNet/IP network connection data.

System Time System time is the absolute time value as defined in the CIP Sync standard in the context of a distributed time system where all devices have a local clock that is synchronized with a common master clock. In the context of Integrated Motion on the EtherNet/IP network, System Time is a 64-bit integer value in units of microseconds or nanoseconds with a value of 0 corresponding to January 1, 1970.

Time Offset Time offset is the System Time Offset value associated with the Integrated Motion on the EtherNet/IP network connection data that is associated with the source device. The System Time Offset is a 64-bit offset value that is added to a device's local clock to generate System Time for that device.

Time Stamp Time stamp is a system time stamp value that is associated with the Integrated Motion on the EtherNet/IP network connection data. The time stamp conveys the absolute time when the associated data was captured, or can be also used to determine when associated data is applied.

Variable Frequency Drive (VFD) Variable Frequency Drive (VFD) is a class of drive products that seek to control the speed of a motor, typically an induction motor, through a proportional relationship between drive output voltage and commanded output frequency. Frequency drives are, therefore, sometimes referred to as Volts/Hertz drives.

TIP The Kinetix 350 drive does not support the Output Frequency attribute.

Vector Drive Vector drive is a class of drive products that seek to control the dynamics of a motor via closed loop control, which includes, but is not limited to, closed loop control of both torque and flux vector components of the motor stator current relative to the rotor flux vector.

Notes:

Numerics

1756-EN2F 95
1756-EN2T 95
1756-EN2TR 95
1756-EN3TR 95
1756-ENxT
- firmware 95

1756-L6x
- APR 186

1756-L7x
- APR 186

2198-Hxxx-ERS2 227

A

absolute feedback device 183
absolute feedback position 182
absolute position 175, 182, 183
absolute position loss
- without APR fault 192

absolute position recovery 187
active homing 176
active supervisor precedence 237
APR
- absolute position recovery 182
- fault 186
- faults 184
- functionality 183
- incremental encoders 193
- recovery 182
  - battery backed controller 189
  - change controller 189
  - controller 188
  - controller and drives remained powered 189
  - download same program and no hardware changes 190
  - download same program with no hardware changes 190
  - drive 191
  - feedback device 190
  - inhibit or uninhibit 190
  - position feedback 190
  - restore 190
  - RSLogix 5000 project 190
  - scaling 191
- reset 192
- retention 182
- sequence of events 193
- supported components 182
- terminology 182

associated products 11
auto-negotiate 233
axis
- homed bit 183
- homed status bit 186
- inhibit 219
- tune 195

axis configuration types
- compare 32

axis scheduling 77
- alternate update period 82
- axis assignment 81
- base update rate 78
- multiple drives 79
- system performance 77
- utilization 87

AXIS_CIP_DRIVE
- exception actions 216
- exceptions 217
  - alarm 218
  - fault status only 218
  - ignore 218
  - stop drive 217
  - stop planner 218

B

Base 66
base update period
- integrated architecture builder 38, 66

C

CIP motion drive module
- associated axes 240
  - axis 1 242, 243
  - axis 2 243
  - load feedback device 242, 243
  - master feedback device 242
  - motor feedback device 243
- configuring 223
- connection 225, 226
  - electronic keying mismatch 226
  - inhibit module 226
  - major fault 226
  - module configuration invalid 226
  - request error 226
  - requested packet interval (RPI) 226
  - service request error 226
- digital input 247
- ethernet address 225
- internet protocol 231, 233
  - domain name 232
  - gateway address 232
  - host name 232
  - IP address 232
  - primary DNS server address 232
  - refresh communication 233
  - secondary DNS server address 233
  - subnet 232
- module info 229
  - identification 230
  - refresh 230
  - reset module 230
  - status 230
- motion diagnostics 248
  - controller to drive 248
  - course update period 248
  - drive to controller 248
  - enable transmission timing statistics 248
- network 237, 239

active ring supervisor 237
advanced 239
clear fault 239
enable supervisor mode 237
network status 237
reset counter 238
ring fault 238
ring faults detected 238
status 238
supervisor status 238
topology 237
verify fault location 238
port configuration 233, 234, 236
auto-negotiate 235
current duplex 235, 236
current speed 235
enable 235
link status 235
port 235
refresh communication 236
selected duplex 235
selected speed 235
power 244, 245
AC input phasing 245
bus regulator action 245
power structure 245
regenerative power limit 245
power ratings 225
power structure 224
properties 223
revision 225
time sync 228
accuracy 228
backplane state 229
class 228
ethernet state 229
identity 228
local clock 229
offset master 229
source 228
synchronization status 229
variance 228
CIP Sync 17, 93
commission
hookup test 145
Motion Direct Commands 145
CompactFlash 182, 193
CompactLogix 12, 34, 62, 98
coordinated motion instructions
Motion Coordinated Change Dynamics (MCCD) 270
Motion Coordinated Circular Move (MCCM) 270
Motion Coordinated Linear Move (MCLM) 270
Motion Coordinated Shutdown (MCSD) 270
Motion Coordinated Shutdown Reset (MCSR) 270
Motion Coordinated Stop (MCS) 270

D

dependent attributes 149
diagnostics 234
direct commands
motion state 268
direct coupled rotary 146, 147
drive status indicators 214

E

electronic keying 224
EtherNet/IP 231
external bus capacitance 245
external shunt 245

F

faults
major 215
manage motion 214, 215
non-major 215
status 217
faults and alarms 211
action 212
alarms 212
clear log 212
condition 212
data monitor 213
date and time 212
drive status indicators 211
end state 212
faults 212
indicator 212
log 211
quick view 211, 213
source 212
tag monitor 211
feedback configuration types
compare 32
feedback position 182
feedforward 201, 205

G

gains
established 33
gains to tune
customize 33
grandmaster 228
GuardLogix 227

H

home offset 182
homing
axis 175
guidelines 175
hookup tests 152

I

incremental feedback position 182
Integrated Architecture Builder
base update period 66
course update period 38
interface and media counters 234

K

Kinetix 350 12
voltage ranges 13
Kinetix 5500
voltage ranges 13
Kinetix 6500 12
voltage ranges 13

L

linear actuator 146, 149
load type 146, 148
Logix Designer 11

M

machine home/reference 182
MAFR
Motion Axis Fault Reset 199
MAH 183
Motion Axis Home 199
MAJ
Motion Axis Jog 199
MAM
Motion Axis Move 199
manual tune 201
marker homing sequence 175
MAS
Motion Axis Stop 199
master speed 279
MDS
Motion Drive Start 199
MDSC
lock position 279
program rate 280
program time 281
programming 279
Motion Arm Output Cam 269
Motion Arm Registration 269
Motion Arm Watch Position 269
motion attributes
configuration attributes 177
motion homing configuration 18
Motion Axis Fault Reset 268
Motion Axis Gear 269
Motion Axis Home 269
Motion Axis Jog 269
Motion Axis Move 200, 269
Motion Axis Position Cam 269
Motion Axis Shutdown 268
Motion Axis Shutdown Reset 268
Motion Axis Stop 269
Motion Axis Time Cam 269
Motion Calculate Cam Profile 269
Motion Calculate Slave Values 269
Motion Change Dynamics 269
motion configuration instructions
Motion Run Axis Tuning (MRAT) 270
Motion Run Hookup Diagnostic (MRHD) 270
Motion Coordinated Change Dynamics 270
Motion Coordinated Circular Move 270
Motion Coordinated Linear Move 270
Motion Coordinated Shutdown 270
Motion Coordinated Shutdown Reset 270
Motion Coordinated Stop 270
Motion Direct Commands 199
motion direct commands
STO bypas 173
STO bypass 173
Motion Disarm Output Cam 269
Motion Disarm Registration 269
Motion Disarm Watch Position 269
Motion Drive Start 268
motion event instructions
Motion Arm Output Cam (MAOC) 269
Motion Arm Watch Position (MAWP) 269
Motion Disarm Output Cam (MDOC) 269
Motion Disarm Registration (MDR) 269
Motion Disarm Watch Position (MDW) 269
Motion Generator 199
motion group instructions
Motion Group Shutdown (MGS) 269
Motion Group Shutdown Reset (MGSR) 269
Motion Group Stop (MGS) 269
Motion Group Strobe Position (MGSP) 269
Motion Group Shutdown 269
Motion Group Shutdown Reset 269
Motion Group Stop 269
Motion Group Strobe Position 269
motion instructions 170
motion move instructions
Motion Axis Gear (MAG) 269
Motion Axis Home (MAH) 269
active homing 176
passive homing 176
Motion Axis Jog (MAJ) 269
Motion Axis Move (MAM) 269
Motion Axis Position Cam (MAPC) 269
Motion Axis Stop (MAS) 269
Motion Axis Time Cam (MATC) 269
Motion Calculate Cam Profile (MCCP) 269
Motion Calculate Slave Values (MCSV) 269
Motion Change Dynamics (MCD) 269
Motion Redefine Position (MRP) 269
Motion Redefine Position 269
Motion Run Axis Tuning 270
Motion Run Hookup Diagnostic 270
motion servo off 268

motion state instructions
Motion Axis Fault Reset (MAFR) 268
Motion Axis Shutdown (MAS) 268
Motion Axis Shutdown Reset (MASR) 268
Motion Servo Off 268
Motion Servo On 268
motioni event instructions
Motion Arm Registration (MAR) 269
MSO
Motion Servo Off 199
Motion Servo On 199, 268

O

overload and voltage limits 245
ownership 227

P

passive home 175
persistent media fault
firmware error 186
planner 201, 205
power cycle 182
power structure
auto-populate 24
PowerFlex 755 12, 48
customize gains 60
feedback configuration type 60
voltage ranges 13
proportional gains 195

Q

quick watch 207

R

refresh communication 239
rotary transmission 146, 148
RSLogix 5000 programming software
motion instructions 170

S

Safe Torque Off 173
troubleshooting 174
scaling 146
off-line 145
online 192
signature 191
secure digital 182
card 193
shunt regulator resistor type 245
shutdown 217
single-axis 13
slave speed 279
STO
bypass 173
stop drive 217
Studio 5000 11
system performance 38, 66

T

time synchronization 92
set 92
trapezoidal 175
troubleshoot faults
instruction error 214
tune
compensation 201, 205
feedforward 201, 205
filters 201, 205
limits 201, 205
manual 195
tuning parameters
customize 195

V

velocity profile effects 258

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support you can find technical and application notes, sample code, and links to software service packs. You can also visit our Support Center at https://rockwellautomation.custhelp.com/ for software updates, support chats and forums, technical information, FAQs, and to sign up for product notification updates.

In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/services/online-phone.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/rockwellautomation/support/overview.page, or contact your local Rockwell Automation representative.

New Product Satisfaction Return

Rockwell Automation tests all of its products to help ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

United States	Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process.
Outside United States	Please contact your local Rockwell Automation representative for the return procedure.

Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

Rockwell Automation maintains current product environmental information on its website at http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page.

Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication MOTION-UM003F-EN-P - March 2015

Supersedes Publication MOTION-UM003E-EN-P - October 2014

Copyright © 2015 Rockwell Automation, Inc. All rights reserved. Printed in the U.S.A.

Allen-Bradley

Integrated Motion on the EtherNet/IP Network Configuration and Startup

User Manual